RAILROAD GAZETTE

FRIDAY, FEBRUARY 16, 1900.

CONTENTS.

Contributions.

Brake-Beam Patent Suits.

Chicago, Feb. 10, 1900.

To the Editor of the Railroad Gazette:

Our attention has just been called to a circular issued by the Interchangeable Brake Beam Company referring to the patent suits pending between this company and that, and we beg to call attention to a material omission in their circular, viz.: they omitted referring to the fact that the case prior to the date of their circular was appealed to the United States Court of Appeals, and the decision of which Court will determine whether "the railroads can use the Interchangeable Brake Beam freely" or not.

We think it only proper that attention should be called to the fact that the question is yet to be finally determined, and is still "in the court."

CHICAGO RAILWAY EQUIPMENT COMPANY,
Lessee National Hollow Brake Beam Company.

The Theory of Velocity Grades.

Roanoke, Va., Jan. 29, 1900.

To the Editor of the Railroad Gazette:

The writer notes with pleasure the extended discussion of this subject, believing that the result will be a clearer understanding of it than appears to have existed heretofore.

The expression $P = \frac{4D}{S + 10}$ was deduced from the broadest view of the matter, both as to the extent of the landscape and of the image on the retina, that the writer was capable of; having in mind that it is not desirable generally to build a velocity grade for any one particular type of engine, and that it should not be built capable of use to its limit on state occasions only, but on work days as well. He will not attempt to prove the accuracy of the expression in detail, but as an indication of how it agrees with modern practice the data given by Mr. Raymond on Jan. 16, having the stamp of authority, will answer as well as any other.

The formula gives in effect the percentage of the weight on driving wheels that may reasonably be expected to equal the traction, at the rails, at given speeds. For instance, at 30 miles an hour the traction is given by the formula as 10 per cent. of this weight. In the following table columns 2, 3, 4, 5 and 6 are the actual percentages as given in the data of Mr. Raymond; column 7 is the average percentage at each speed; column 8 is the percentage as given by the expression of the writer; column 9 is the percentage of Mr. Raymond's ideal engine of Jan. 16; and column 10 is reserved for the percentage advocated by "Kicker":

Table of Traction as a Percentage of Driving Wheel Weight.

1	2	3	4	5	6	7	8	9	10
Speed miles per hour.	Simple mogul.	Simple consolidation.	10-Wheel compound.	10-Wheel simple.	Compound mastodon.	Average.	Wentworth	Raymond.	"Kicker."
5	24	26	23	..	30	26	27	24	24
10	21	22	21	24	24	22	20	24	24
15	17	16	18	21	19	18	16	16	24
20	13	11	15	18	15	14	13	12	24
25	10	8	12	15	12	11	11	10	24
30	..	.	10	12	9	10	10	8	24
35	..	..	9	10	..	9.5	9	7	24
40	..	..	8	9	..	8.5	8	6	24

In calculating column 9, the traction is limited by the adhesion up to a speed of 10 miles an hour, and adhesion is taken at $\frac{1}{4.25}$, or 24 per cent. This fixes the horse power of the engine at what is necessary to exert this traction at 10 miles an hour; and from this speed on the horse power is constant. At 20 miles an hour, then, the traction must be 12 per cent., and so on for the rest; the product of speed by percentage being the constant 240. This is believed to be a correct statement of Mr. Raymond's position. "Kicker" boldly insists on the traction being equal to the adhesion at all speeds, so he is given a uniform 24 per cent. all down column 10. Who comes closest to the actual average, "Kicker," Mr. Raymond or the writer?

If Mr. Herr's engines be taken as typical, the question is: Are the percentages of the writer close enough? The answer is that, inasmuch as at slow speeds, when the traction is limited, by adhesion alone in most engines, the adhesion itself can not be predicated within a range of 5 per cent. of the weight on driving wheels at all times and seasons, to insist on strictly accurate figures in the remainder of the scale is to strain at gnats and swallow camels. The camel in this case is the traction at slow speed, which is after all the governing factor, as then if at any time, the wheels begin to slip and the engine to stall.

Here Mr. Raymond is too low in his percentage, for sand can be, and is, used to increase adhesion. Also a formula has the advantage over a theory, supposing both to be equally accurate, in that it can be put to algebraic use.

Mr. Raymond is right when he says that some engines can nearly utilize their full adhesion at 10 miles an hour, but this is just the use of an excessive value for traction, which the writer wishes to avoid in planning new velocity grades. At 22 miles an hour Mr. Raymond's engine only has a traction of 11 per cent., whereas on Dec. 14 he questioned the propriety of the writer's use of 12½ per cent. at that speed. Now he out-Herods Herod.

He objects to formula VII. of Nov. 30 (Railroad Gazette, Dec. 8), because it does not show how long a velocity grade may be. If he means it does not show how long a velocity grade must be for given engine, train, and limiting speeds, he is right. Formula VIII. does this. Formula VII. gives the maximum length of velocity grade possible for given limiting speeds; these are the only factors that appear in it. If the weight of train and engine is given also, formula VIII. gives the maximum velocity grade; because if the speed is reduced to the assumed final in a less distance than given by formula VIII. the engine will not be doing its full duty; and if the assumed final speed is reached at a greater distance the train will be less time in passing over this distance than it would be if the final speed was reached at the point fixed by the formula. This means that a certain amount of work will be done against gravity in less time than it is possible, which will result in a necessary decrease in tonnage. Numerical examples would indicate this point, but would be too long for insertion here. All velocity grades so found will be shorter than the maximum grades found by formula VII., the limiting speeds being of course the same throughout. Reference is made to formula VII. as generalized in the communication of Dec. 26 (Railroad Gazette of Jan. 5.).

The writer has not made a column for Professor Allen, and regrets he would have to put him in column 10; as there is no indication in his article of Jan. 12 that he appreciates any variation of traction at different speeds. While he gives no clue as to his idea of what tonnage may be taken over his grades, he leaves the inference to be drawn that as many tons can be handled on a rise of 7½ feet, for instance (Fig. 1, of Jan. 12), by a broken as by a uniform grade. This is incorrect, for at the prescribed speeds the engine would be 59 seconds in one case and 69 in the other in doing the same amount of work against gravity. In practice an engine is not permitted to wander jauntily over the right of way whistling as it goes, perhaps, for want of thought. On the contrary, its burden is piled up by the White Man to the utmost ton. When it is given all it can handle on the uniform grade in 69 seconds, it will not be able to take the same train over the broken grade in 59 seconds, the total distance being the same in both cases. How many less tons it can haul or what the final speed will be if the full tonnage be insisted on, may be estimated by the method of the writer.

The objection to the form of theory discussed by Professor Allen is that it treats of the motion of a body, impelled by a constant force, and with constant resistances. To stop here would be leaving theory in the shape that has justly discredited it with practical men. The problem is: What is the motion of a train, drawn by a locomotive, on a railroad? In solving this his straight lines will become curves, and he will be forced to fall back on the use of the formulas he depreciates.

If, for instance, the engine used weighs 150,000 lbs. on driving wheels, and the resistance of friction is assumed at 6 lbs. per ton, the total weight of train that can be handled on the 0.5 grade at 15 miles an hour is 1,500 tons. On the broken grade, if the speed at station 15 must be 15 miles an hour, the total weight of the train reduces to 1,388 tons; and the speed at station 10 will be 19.4 miles an hour. If it be desired to have the train weigh 1,500 tons, that passes over the broken grade, the speed at station 10 will be 18.9 miles an hour; and the final speed at station 15 will be only 14.2 miles an hour. The differences would be more marked but for the shortness of the grades.

CHAS. C. WENTWORTH.

To the Editor of the Railroad Gazette:

In their criticisms of my article of Jan. 12, 1900, on Momentum Grades, both Prof. Raymond (Railroad Gazette Jan. 26, p. 49) and Mr. Wentworth [above] seem to have made assumptions as to meaning for which the writer finds no warrant. That article did not intend to, nor did it, enter into any controversy as to the proper amount of traction at various speeds, neither did it go into the question of train resistance at various speeds. It was intended to develop somewhat fully the principles underlying the question of momentum grades, more particularly for those who had not investigated the subject, and to point out general methods of treatment. Under (a) it was shown what would happen if an engine should "exert a uniform pull from 0 to 15." A case was taken with uniform pull for the sake of simplicity, in order more readily to introduce to the reader certain principles. Mr. Wentworth says of the writer "he gives no clue to his idea of what tonnage may be taken over the grades." That was not intended. Mr. Wentworth draws "inferences" thereupon and finds in effect that if the pull was not uniform but decreased, the speed at Station 10 would be slightly different from what I found it to be for the "uniform pull" assumed. This does not properly constitute a criticism of my treatment. In (b) again a simple case is taken where the pull is uniform. In (c) it is stated that a "virtual grade line" "may be drawn with an inclination which marks the maximum grade at which a locomotive can haul its train at uniform speed (or which represents the pull which it is intended it shall exert)." Prof. Raymond says "Prof. Allen uses the virtual grade for the minimum speed rather than the mean tractive force. This method gives lengths of grade probably much too great." In answer, let it be said that it is nowhere stated there that the writer uses the virtual grade for the "minimum speed". The proper grade to use is the grades that does take into account the mean tractive force as well as the mean train resistance. Approximately it will be the grade based upon the tractive force and train resistance for the mean velocity. On a straight grade it would be more nearly correct, as well as conservative, to use a grade slightly less than that due to the average of the maximum and minimum speeds. In a similar way in Fig. 4, the grade of +0.50 should represent the ability of the locomotive at about its average speed, or for conservatism, for a speed slightly in excess of the mean. All that is necessary is that the ability of the engine shall be represented in the form of rate of grade, which is a common procedure in investigating train resistances.

In another place, Mr. Wentworth thinks that in solving questions of mementum grades, Prof. Allen's "straight lines" (of virtual grades) "will become curves, and he will be forced to fall back on the formulas he depreciates." Mr. Wentworth here temporarily loses sight of the fact (which in another number of the Gazette he shows he clearly understands) that his own formulas are straight line formulas. He uses the mean of the traction at the maximum and the minimum speeds. My straight lines, based upon the same data, are as good as his formulas, and in fact, are in effect precisely the same things in different form except that, apparently, Mr. Wentworth's formulas do not take into account the change in train resistance due to change in speed; he takes into account the change in traction only.

There is no doubt that the virtual grade line is theoretically a curved line. A decrease in train resistance with decreased speeds would cause this; any increase that would occur in traction at lower speeds would also have the same effect. But who shall tell me by what law train resistances vary with velocity? Some say as V, some say as V^2, and neither of them knows the truth about it. Who will tell me how traction varies with velocity under the conditions of operation on a momentum grade? Prof. Raymond and Mr. Wentworth fail to agree completely, and there is at least a possibility that neither is right. Isn't it a refinement to try to use a curved line whose position you cannot determine, when a straight line can be used which will give results probably as near right as your knowledge of the subject will warrant; when the straight line can be readily made to lie nearly in proper position but on the conservative side; when the straight line will allow simplicity of solution? Mr. Wentworth believes in the straight line for he uses it. Now the writer is disposed to believe that without intending to misinterpret anything in the article of Jan. 12, Mr. Wentworth and Prof. Raymond were both so hot on the trail of traction influences that they saw inferences as to traction in

many a line of that article, although there was nothing of the sort there. The writer still believes that the method of treatment in the article of Jan. 12 is more simple than one involving the use of formulas at every step. He cannot object to the use of any formula for train resistance or any formula for traction which any engineer may find to represent the facts. All such considerations can have effect given them in fixing the rate of grade which shall represent the ability of the engine at about the average speed, and this grade may be made to lie as far on the conservative side as seems best to each engineer, and if desirable may easily and intelligently be made more conservative in some cases than in others. In this way the method allows greater elasticity than a rigid formula.

C. FRANK ALLEN.

Signaling As It Is and As It Might Be.

THE EVOLUTION OF THE SIGNAL DEPARTMENT.

BY A. H. RUDD.

(*Continued from page 50.*)

It will be noted from the preceding article that the preliminary and experimental work was largely done before 1888, and that the last 12 years comprises the period of actual development.

In the early stages of railroad operation, the division superintendent was supreme, having under his immediate personal control all the operating branches of the business. He was superintendent of transportation and of motive power, traffic manager, car accountant, chief engineer, road master and superintendent of buildings. As business increased, and the roads developed, it soon became evident that no man could carry this burden in detail and improve the service as the public and the stockholders demanded.

One after another the different great departments were organized, and specialists were sought and established as the responsible heads. The telegraph revolutionized the work of the transportation department, the chief dispatcher becoming an important man. Lastly, not over a dozen years ago, the signal department, the baby of the family, had its birth. By reason of its late advent it is still in short trousers, and, in many cases, not yet out of its swaddling clothes. But is it not almost time now that it be given a voice in the councils of the family? Although young in years, it has demonstrated itself to be a very precocious youth, and has developed fast.

For many years fixed signals were regarded entirely in the light of luxuries. At present they are looked upon in many quarters as a necessary evil, and not even the most liberal managements regard them as an entirely unalloyed blessing. In most cases the signal department "was not born, it growed." The exceptions to this are few. There have been some lines on which the signal engineer was appointed, and the work installed under his direction, largely by contract and covering whole divisions at a time; but the usual development has been the installation of isolated plants, and, after the number of them had for some time warranted it, the establishment of a department. This is about the way matters stand to-day.

Referring now to interlocking, how familiar to contractors is the plan of tracks submitted for signaling. No consideration has been given by the engineering department, in its arrangement, with a view to making simple and perfect signaling easy, and a "forest of masts" arises (on paper) as one signal after another is added, absolutely necessary for proper working, but which might have been easily dispensed with by a slight rearrangement of the tracks. The additions made, the transportation department steps in. "This will cost too much money; there are too many signals; this move is rarely made; cut out that signal; this move will never be made except in emergency" (when signals are most needed); "we will give hand signals at such times. Now cut off 10 per cent. and we will talk with you." The revised plan goes through, and the work is installed, usually without supervision, or at best under that of some official entirely unfamiliar with the work. The signal companies, let it be said to their credit, usually give good return for the money expended, but either the ten per cent. deducted must be made up in some way, or their profits are nil.

After being put in service, the plant, if an isolated one, is cared for by the road department, whose man oils it semi-occasionally and sweeps out the sand when it gets working too hard; or by the motive power department, whose shop mechanic, a good man in his own line, makes repairs when absolutely necessary, or more frequently after a break down has caused a tie up; or by the carpenters of the bridge or building force, who perhaps built the tower, and consequently must understand all about its contents! The person in charge, not understanding the first principles of safe signaling, sometimes proceeds, if a wire breaks, to tie the arm in a clear position until repairs are made, because "we must get our trains over the road."

Then the impossible occurs, and movements are foud necessary that "never will be made." Hand signals are resorted to, with the inevitable result; a switch run through trailing perhaps, a case of rattles, or attempt to shift responsibility, a back up move over the broken switch, something on the ground, and—more repairs. The signal company's agent, always on the alert, then appears upon the scene. "Let us complete the signaling for you at this point, and these troubles will be avoided in future." The reader can guess the reply: "We want no more of your apparatus; it is always out of order."

We buy magnificent locomotives. Are they inspected by competent men before being accepted? Are they allowed to run without further inspection until they break down? Are they repaired by track or bridge men? When purchased, are they required to be complete, or do we leave off the head lights because the engines will be used only on day runs? Do we dispense with whistles because city ordinances prohibit their use, while in the country they are seldom needed, and in emergencies the bell can be sounded or the engineman may yell? Some dollars could be saved in this way, but the method is not employed. Signal plants are, however, installed incomplete for similar reasons. Hand signals are given where none should ever be resorted to except in the rarest emergencies, which have their parallel in the breaking of the headlight or the whistle.

Does anyone consider two bolts to an angle bar and one of them broken the proper thing in good track? Why are tracks inspected daily and trestle bridges patrolled frequently? Because, although it all costs money, it is the safest way and the cheapest in the end.

Why, then, in the name of common sense, should signal plants be installed without inspection and turned over to the tender mercies of men skilled in their own lines, but absolutely incompetent to perform work for which they have received no training?

This condition has existed, and it exists to day, in many places. The remedy lies with the managing officials, and no one else.

At the next stage in signaling development we find a signal fitter from the contracting company detailed as repairman. He fills the bill, but if he is disabled or leaves the service, no one is qualified to take his place. If additions are required they must be made by contract, for how many fitters can apply the proper locking until the plans have been provided for their guidance? How many shop men can build even a part of a locomotive offhand?

The reason for this state of things is, as already intimated, that the intricacies of the work are not realized by the higher officials because the development has taken place since they were graduated from the school period of their railroad careers. And this does not imply any failure to keep abreast of the times either. Details of other departments are left to their heads; but with no department and no head, signals are in a sorry plight.

A case is known to the writer where a Pennsylvania Steel Co.'s machine was used to operate derails with lock and switch movements at the crossing of two double track trunk lines. As a wheel was revolved the derails were closed and locked and a further revolution cleared the home and distant signals in both directions on one line simultaneously. The detector bars were removed in the fall to avoid cleaning during the winter. In the same tower with this machine was a four-lever old-style Johnson, in no way interlocked with the other, but controlling a crossover and switch within the limits of the derails, said crossover being protected (?) by dwarf signals normally clear when levers were home. Enginemen received both high signals and the dwarf for one move, and the high signals only for another, running against the dwarf.

This is a fair sample of signaling under the conditions just described. Fortunately such work is now largely a thing of the past, though there are some cases as bad still to be found in actual practice.

With electric signals, if of simple form, the problem was less difficult. These, as soon as installed, were usually placed under the supervision of the Superintendent of Telegraph. His line men, being familiar with the care of batteries, relays and wires, easily learned in a few weeks to take ordinary care of the signal apparatus, and they did it if nothing more important was on hand.

This was a good organization and is carried out in several instances to-day. The natural increase of the work in time outgrew this arrangement entirely, necessitating the appointment of a separate official, or at least modifying it so as to have a foreman in direct charge reporting to the Telegraph Superintendent. But the latter, when called upon, in addition to his other duties, to supervise the erection and care of interlocking plants, is sure to be overburdened, and at all events is usually beyond his depth. In short, the whole business resolves itself into the old saw of the shoemaker and his last.

Let us now consider the third stage of the game; when the shoes to be repaired are so numerous that the shoemaker must be found, and some division superintendent "wearied and ill at ease" decides to appoint a signal foreman to take the load off his shoulders.

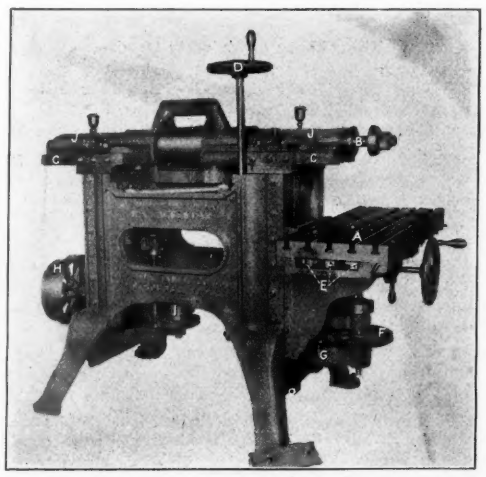
Where is the man to come from? Is he to be one of "our own men" or an "outsider"? The preference is usually given to the former, in which case the appointee must learn the business through actual experiences, and meet troubles as they appear. Not being acquainted with the work, he is liable to make costly, and at times dangerous mistakes. If an experienced signalman is desired, he is usually found with the manufacturers, and as the railroads generally pay lower wages than the latter, the only inducement for him to change is the promise of a "steady job" and the hope that he may not have to continually "live under his hat." While he has perhaps made a record on construction, he may fall by the wayside when maintenance problems confront him, and then he either loses his "steady job" or the company suffers. Only in exceptional cases will the signal companies part with their best men. The demand for good men is large, the number of them few, and so in many cases the policy obtains of employing mediocre talent, because it can be obtained at a lower price; and this in the face of the fact, that most of the roads—at least those which memory of actual examples now calls to mind—can amply afford to pay high wages, and their managements well know that the best is the cheapest in the end.

[TO BE CONTINUED.]

The Newman Emery Planer.

The Tanite Co., of Stroudsburg, Pa., recently built for the Pennsylvania Railroad shops at Altoona a Newman emery planer, larger, heavier and more substantial than those which have been for some years in use. The increased size of locomotives has called for this bigger machine, which is used for grinding parallel rod straps, slide valves, links, shoes and wedges for driving boxes, etc. It is especially useful in repair work.

A peculiarity of this machine is that while the bed A moves slowly, like the bed of an ordinary planer, the emery wheel, which is mounted on the sliding frame C and on the revolving spindle B, has a traverse motion at right angle to the motion of the bed. The table has three feeds, giving motions of $3\frac{11}{16}$ in., $5\frac{5}{32}$ in. and $8\frac{1}{32}$ in., each in two minutes. The piece to be ground is held in a chuck on the table and has a slow backward and forward motion while the emery wheel spindle revolves at such a rate as to give a speed of 5,500 ft. per minute to the circumference of the wheel whatever the diameter may be. While the planer bed is thus moving slowly backward and forward and the wheel revolving at



The Newman Emery Planer.

over a mile a minute, the frame C, with the emery wheel spindle, makes 31½ throws per minute each way across the table. This variety of motion results in a kind of shear undercut, and it is claimed that the wheel will cut deeper and with less heat and friction than by any other method of application. An emery wheel thus mounted and run has made a throw of eight inches, cutting a depth of one-quarter inch. This, however, is an extreme case. The proper use of the Newman planer is to take light cuts and do approximately correct work on case-hardened or other very hard metal.

The machine, including the chuck, weighs about 3,029 lbs. and the weight of the overhead work is 526 lbs. The table is 15 x 42 in. and intended to grind 14 x 40 in. The spindle has a 15-in. throw and is 2½ in. diameter in the boxes. The table has through the hand wheel D a vertical adjustment of 13 in. The racks E are of steel with cut teeth. The large gear F, which controls the table motion, is of iron with cut teeth and the small cut gears G are of steel. The cone pulley H at the left of the machine makes 145 revolutions a minute. The pulleys of this cone are respectively 12½ and 13¾ in. diameter and are driven by a cone on the countershaft. By running this cone shaft at 550 revolutions a minute an emery wheel 10 in. in diameter will be driven at about 5,500 ft. per minute and the various motions described above will be secured through the cone pulley H.

The motions thus indicated are based on the original theory and practice of Mr. Newman, who patented the machine. It is probable that other mechanics would have different theories as to speed and that after experience they might adopt different practices. We believe it is the practice at the Altoona shops to use wheels of more than 10 in. diameter.

The Newman emery planer was originally built for grinding sad-irons, the idea being to make a superior quality of iron by the exclusive use of scrap metal, the iron being too hard to grind with success on a grindstone, but the machine never came into use for that purpose. It has, however, long been used with success for grinding dies. Dies for hexagon or square nuts can, by the use of such a machine, be kept in perfect condition to turn out an accurately finished product. There is no one purpose for which the machine is better adapted than for griding dies in all case-hardened work.

Rail Steel—Its Chemistry and Heat Treatment.

BY WILLIAM R. WEBSTER.*

In your article of Oct. 16, 1899, on the "American Society of Civil Engineers Rail Sections," and that of Jan. 12 on "The Modern Steel Rail," by "Engineer," there is much matter for consideration and discussion which will be of benefit to the railroad companies and the manufacturers by bringing out more definite information on the points raised.

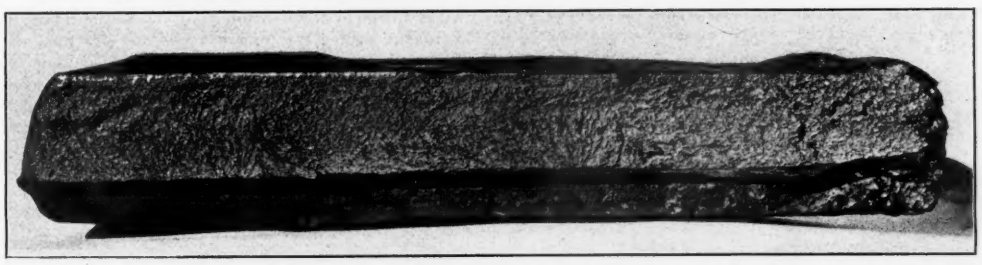
In connection with the claim that the lighter rails formerly rolled gave better results than those of to-day, enough importance has not been given to the cold rolling these old rails received when first put in the track from the light wheel loads then in use. This, in part, accounts for the differences observed, and, of course, as has often been pointed out, it is another case of the "survival of the fittest" as the old light rails that did not give good service were forgotten long ago and are not alluded to at this time.

On all questions of this kind there is much to be said on both sides—the manufacturers have many practical difficulties to contend with that are not generally understood by the engineer. If the case was as simple as it has been made to appear, it would seem as though the trouble should be corrected at once and each road given just exactly what it wants as to quality of material and service of rail in the track; to the mutual satisfaction of the manufacturer and the consumer. But, unfortunately, this is anything but an easy problem, and in order to understand it thoroughly we must refer to what is really known of the changes in the structure of steel due to heat, and again, the modifications of these changes due to work of rolling.

The following is a modification of Mr. William Metcalf's beautiful experiment, and illustrates as well as anything we have the changes due to heat.

A 4 x 8 inch bloom of forty carbon steel was heated and hammered to 2¼ x 12 x 12 inches, and nicked across on the center line and then allowed to cool, after which it was placed in a smith's fire until one end became white hot and the corners of the extreme end melted off, the other end of the bar being exposed to the air and not heated to any great extent.

The bar was withdrawn from the fire and allowed to cool in the ordinary manner, after which it was placed on supports and broken along the nicked line. One end of the fractured bar shows the material in its original condition, and the other shows the grain



A Bar of Steel Heated at One End and Broken—Webster.

getting larger as the heat had been increased. The photograph does not do justice to this, but one can understand from it the general character of the changes that have taken place.

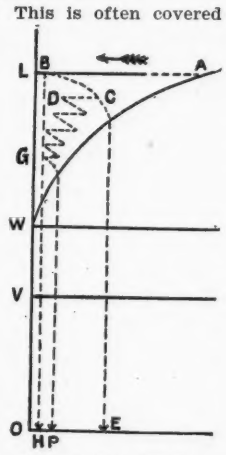
These changes are greater for high carbon steel than for low, and are increased by the impurities present in the steel. Slow cooling will also increase the size of the grain when steel is overheated.

The effect of work of rolling on steel as modifying these changes is well shown by the following, taken from Prof. H. M. Howe's "Metallurgy of Steel":

"Our first question is the superiority of thin pieces due to lower finishing-temperature or to greater reduction or both, and if to both in what proportion to each, is not easily answered, since the finishing temperature usually sinks as reduction increases. That is to say, if we start with ingot or pile of given size, then the greater the total redutction the lower also will be the finishing temperature. Hence we should expect common practice to answer equivocally, and should look to special cases, in which these two variables do not vary alike, for light. Nor do we look vainly.

"To make this question of the finishing-temperature clear, let ordinates in Figure 118 B represent temperature and abscissae coarseness of grain. Now, the line A W may be taken as representing roughly the size of grain which steel of given composition tends to assume with varying temperature, or the line of maximum coarseness of grain. If the grain be smaller than the maximum for existing temperature it always tends to grow and to approach that maximum. If it be coarser than that maximum it does not tend to shrink back toward the maximum, except when the temperature is rising past W. Let us suppose that we cease rolling a piece of steel while its temperature is at L, the mechanical work of the rolls having broken the grain down, and reduced its size to B. During subsequent cooling the grain will grow, somewhat as sketched in the line BCE. If, however, we resume rolling when the grain had reached C, we will again break down the grain, and drive it back to D. And so, keeping on, between passes the grain grows and the temperature simultaneously falls, while at each pass the squeeze which we give the metal breaks up the grain, and the curve of grain and temperature follows the zigzag line BCDG.

"If we cease rolling when the temperature has fallen to G, then the grain will grow as the metal cools till the line of the actual size of grain intersects that of the maximum size, the line AW; with further cooling no further growth ensues, and the final size of grain is OP. If we had quenched the metal while at G, the final size of grain would have been OH. If we had ceased rolling when the temperature was at L, the final size of grain in the cooled steel would have been OE. Needless to say, far from pretending that these curves are drawn to scale, I cannot even insist that their general teaching is true; but it certainly seems to harmonize with our phenomena."



Howe's Fig. 118 B.

This is often covered by the statement that all work above a given temperature of steel merely changes its form without changing its structure, and that the work at the lower temperature elongates the grain and produces the fine structure.

As the size of the piece of steel rolled increases, the trouble of controlling the finishing temperature also increases as the large mass holds much more internal heat, and steel of the very best chemical composition may be rendered brittle and worthless (in that condition) by being finished at too high a temperature. This trouble is again increased by trying to roll heavy sections in a light mill; but the worst of all to contend with is a heavy section of high carbon steel on a light mill.

This gives some idea of the problem before us, but this is not all, as the effect of carbon or any other element present on the physical properties of steel cannot be considered alone, as all the elements present must be considered: that is, for instance, a given amount of phosphorus has more effect in the presence of high carbon than with low carbon. The section of material rolled must also be taken into account, as the same chemical composition gives lower results in the heavy sections than in the light on account of the higher finishing temperature.

We can to-day, better than ever before, tell the effects due to the chemical composition of the steel, and distinguish the effects due to work of rolling. In this connection I will quote the following from one of my former papers.*

"The objection has been raised that the chemist only gives the total carbon present in the steel, and not the condition in which it exists, and that we cannot expect to predict from this total carbon what its physical effect will be, as in one case we may have more of the hardening carbon present than in another for the same total carbon. This objection is not as important as it seems; for the form of the carbon present depends largely on the heat-treatment, and that is again modified by work of rolling; therefore, if we take any given grade of steel, and by experiment determine the physical effect of different heat-treatments in connection with work, we have the direct answer instead of waiting for the proportion of hardening carbon present to be given by the chemist or microscopist. We know to-day that as carbon increases, the differences due to heat-treatment or finishing temperature in rolling are much greater than in the lower carbon steels. This is no doubt due to the greater change in the form of the carbon present. It calls for a little more leeway between the high and low limits of ultimate strength in specifications, and much closer vigilance as to heating and finishing temperatures in rolling the higher steel. Microscopic examinations will, of course, be of the greatest service in this connection, and will give us definite information on many points that are now in doubt."

I have been working for years on this problem of the relations between the chemical constitution and physical properties of steel, and reduced it to a practical working basis, by which the manufacturer has a safe means of grading his steel and rolling it into the finished product without allowing it to lose the original casting heat. This work has been on the lower carbon, bridge and boiler steels, but the general results will apply just as well to the higher carbon steels for rails or forgings.

In rails, the chemical composition and heat-treatment are of equal importance, and we must not overlook one in considering the effects of the other; yet this is done, and cases cited where good rails chemically have given poor results, and where rails of inferior chemical composition have given good results; also where rails of low carbon steel give better wear than those of higher carbon steel. These differences might have been, and probably were, produced by differences in the heat-treatment of the rails, and the conflicting results are not a sound argument against using chemical composition as a guide, but they are the strongest plea for paying the closest attention to what may seem to many small matters in the rolling and manufacture of steel rails. The problem must be considered as a whole, that is, the composition of the steel, its manufacture, heat-treatment, and the section of the rail.

In our rails it is safe to say, for the sake of argument, that the total reduction from ingot to rail is sufficient, for when you go into much larger ingots you get into another serious trouble from segregation, and the impurities in the steel may be much increased in some of the rails from this cause.

In all rails there is a large mass of metal in the head that holds the heat much longer than the thin metal in the flanges. This at once shows the great difficulty in finishing the head at a low enough temperature, as the light flange cools too quickly, and you cannot after this continue the work of rolling on the head down to a sufficiently low temperature.

In the heaviest sections of rails this difficulty is greatly increased as the large head holds the heat much longer than in the lighter sections. Each point of carbon added in these heavy rails makes it still more difficult to produce a fine structure in the head of the rail, as a finishing temperature that would give satisfactory results with the medium carbon heavy rail might be too high for the higher carbon steel and give a coarse structure. In any case, as the carbon is increased the phosphorus should be kept down or the rails may be made brittle from that cause.

In order to overcome these difficulties several plans have been tried with more or less success, but the problem is not solved yet. Some years ago, Mr. John Fritz suggested that just before the finishing pass the rails should be placed in a long furnace kept at a low temperature, in order that the metal in the head might cool down slowly, and that in the flange be gradually heated up to a proper finishing temperature. This would cause little or no delay in rolling as the action of this furnace would be continuous, and it is merely to equalize the temperature of metal in the head and in the flange in order that the whole rail can be finished at the right temperature. This, no doubt, would overcome the difficulty provided you do not get into another one, by the size of the grain in the metal in head of rail increasing by the slow cooling, as this treatment in the furnace would very much favor the formation of a coarser structure, and there might not be enough work in the finishing pass to draw it down to a fine grain.

The beneficial effect of finishing a heavy rail at the proper temperature in rolling is shown in re-rolling heavy rails that have not given good service in use, but after this second rolling they have given satisfactory results. This is accounted for in the first place by the annealing action of the furnace in heating the rails up to a low heat for rolling, the coarse grain being removed in this way, and they are not heated up high enough to form it again. Then the final work of rolling on the head is at a low temperature, as the flange is in a condition to allow this work at proper temperature. But this is not the same as the case referred to above, as in the one you may start with a coarse grain and follow with little work, while in the other you have a fine grain and more work.

This is a case that engineer and the steel makers could discuss to mutual advantage; it certainly would result in a greater use of the American Society of Civil Engineers' rail sections, as they are the best

*Consulting and Inspecting Engineer, M. Am. Soc. C E., M. Am. Soc. M. E., M. Am. Inst. M. E.

* Relations Between Chemical Constitution and the Physical Character of Steel Transactions, A. I., M. E., Vol. XXVIII., 1898.

(and the mills can do so much better work when they concentrate their efforts on a given section of rail, instead of changing from one to the other all the time), and the Society sections have more to recommend them than any others in use, as you get the most for the weight in metal. But notwithstanding all this, a full discussion of the problem may show that the true way to make a better rail of heaviest section is to put more metal in the flange and web—not to add strength to the rail, but to carry the heat in rolling, and allow the head to be finished at a lower temperature in order to produce a finer grain and better wearing rail. This at first sight seems an expensive way to reach the result, but due consideration may show it to be otherwise. It is offered for what it is worth.

The railroad companies have not enough data at the present time to assist the mills in duplicating an order of rails that have given the best results. They, of course, in a general way, know how the rails were made, but they have not this information in detail, and cannot check up in all respects the quality of the steel they are receiving in their rails on new orders. From this I do not mean to intimate that an engineer should interfere with a manufacturer's business, or that after a contract has been placed to ask for any additional tests that were not provided for originally, but I do want to call attention to the valuable information that can be arrived at from the very simple and inexpensive drop-tests on short pieces of rail. These tests are one of the best checks that we have on the finishing-temperature of the steel, yet in many cases they have been omitted and are often not given the credit for showing the character of the steel. I admit that such tests do not show all that could be desired, but they are much better than tension-tests for rails, and it is the best test that we have to-day. They should be made on small pieces of rail (some with head up and some with head down) placed on solid supports. If the steel is of the right composition to start with, and proper care is used in its manufacture, a uniform rail will be produced if proper reductions and a uniformly low finishing-temperature are used. It is this finishing-temperature that can be best checked by the drop-tests; and some of our rail-makers think so much of this test that they make it on each heat of steel for their own guidance, while other manufacturers do not make any more of these tests than they can avoid. Certainly both parties cannot be right. It has been claimed that the requirements of the drop-tests are too easy for the heavy-weight rails. This may be the case, and if so, the requirements of these tests will no doubt be increased as the quality of the rails is improved. It is a matter that has not received sufficient attention up to this time for anyone to make too definite statements regarding the tests of the heaviest section rails. The drop-tests are a check against brittleness, and a guard against rails that would break in service. I regret to state that we have more cases of one-hundred pound rails that have broken in service than is desirable, and it is of the greatest importance to correct this difficulty by using the very best steel chemically, and then to roll it under the best possible conditions to produce a fine grain structure.

As to the inspection of steel rails, it is too often classed by our railroad engineers with that of the inspection of ties, and it is generally the men who will do the work the cheapest that they are looking for; or they may consider inspection of so little importance that it is not made at all. Under these conditions they are hardly in a position to tell the mills that they are rolling the rails too slowly or too rapidly, or that they have not properly increased the amount of hardening elements, etc., etc. What the railroad companies really do want is all the information they can get on rails rolled on their orders, and then to have an accurate record kept of their behavior in service. This would soon give them facts to present in placing future orders. It would lead, no doubt, to modifications of our present specifications to the mutual benefit of all concerned; but in the meantime, much can be gained by discussing the points already raised, especially as they will bring out others of equal importance.

The Tractive Power of Two-Cylinder Compound Locomotives.

By C. J. Mellin.*

One of the subjects in modern locomotive engineering that is not generally clearly defined is that of the calculation of the tractive power of compound locomotives. It is customary to make the high-pressure cylinder of the compound a certain proportion larger than the cylinders of a corresponding simple engine, which method, while serving the practical purpose, is not satisfactory when the problem is handled independently for the compound and is subject to error as the cylinder proportions vary.

The fundamental principle for calculating the tractive power of a compound locomotive is based on the low-pressure cylinder and the amount of steam used per stroke of the piston. This determines the number of expansions, and with them the average pressure. The former is obtained from the volume of steam that enters the high-pressure cylinder, plus the cylinder clearance less the amount of compression. Let N = number of expansions; A = area of low-pressure cylinder; a = area of high-pressure cylinder; C = cut-off in high-pressure cylinder; b = clearance, and f = compression in high-pressure cylinder, we have $N = \frac{A + a\,(b - f)}{a\,c + a\,(b - f)}$. (1)

Since N is found, we find the theoretical average pressure $P_1 = \frac{P\,(1 + \text{hyp. log.}N)}{N} - 15$ (2).

Where P = the intial pressure, which at slow speed is = to boiler pressure + the atmosphere, but as the cut-off pressure necessarily falls below the initial pressure and as there are other causes of loss, the actual average pressure P_{11} will be about 80 per cent. of P_1. Then the tractive power $T = \frac{d_1^2\,P_{11}\,S}{2\,D}$. (3), in which d_1 = diameter of low-pressure cylinder; S = stroke of piston and D = diameter of drivers.

By applying these formulas to a given engine, say 21 in. and 33 in. x 26 in. cylinders, 56 in. diameter of drivers and 200 lbs. boiler pressure (P = 215 lbs.) C = 85 per cent.; b = 8 per cent., and f = 2 per cent. of a. A being 850 square inches, and a = 340 square inches, we have from formula (1):

$$N = \frac{A + a\,(b - f)}{a\,c + a\,(b - f)} = \frac{850 + 340\,(0.08 - 0.02)}{(340 \times 0.85) + 340\,(0.08 - 0.02)} =$$

2.81 expansions.

The hyperbol. logarithum for 2.81 = 1.0332, hence we get from formula (2):

$$P_1 = \frac{P\,(1 + \text{hyp. log.}N)}{N} - 15 = \frac{215\,(1 + 1.0332)}{2.81} - 15 = 140.5$$

lbs., and the actual average pressure $P_{11} = 140.5 \times 0.80 = 112.4$ lbs.

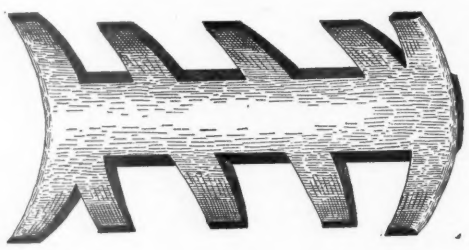
By inserting the value of P_{11} in the third formula, we get

$$T = \frac{d_1^2\,P_{11}\,S}{2\,D} = \frac{33 \times 33 \times 112.4 \times 26}{2 \times 56} = 28{,}411 \text{ lbs., tractive power.}$$

*Chief Engineer Richmond Locomotive and Machine Works.

A New Journal Bearing.

The Spiral Journal Bearing Company, St. Louis, has recently moved to 1543 and 1545 North Second Street, so as to have larger quarters, and additional machinery and brass foundry equipment has been added. In addition to making the usual form of railroad car brasses, this company has brought out a special brass which consists of a combination of a shell of hard brass or malleable iron, a skeleton bronze lining, shown by the accompanying engraving, and a lead lining. The skeleton bronze lining is acid cleaned, bored and tinned and is then placed in the outer stell, the white metal, when poured,



binding the parts together. Lugs are cast on the bronze lining so it will be held in place should the lead lining melt out; the brass then having sufficient bearing surface to insure against breaking. When the bearing is worn down to the bronze, the surface is then composed of two metals arranged in alternate sections of spiral form. This construction is said to result in greater strength and a more uniform wear of the bearing and journal, also better lubrication, and consequently there is less chance for heating than with the ordinary brass. When removed from service the shells can be relined, and skelton bronze lining and babitt metal are furnished separately so that this work can be done in railroad shops.

The Locomotive—Recent Practice and the Future.*

By F. W. Dean.

At the January meeting of the New England Railroad Club Mr. F. W. Dean presented a valuable review of recent locomotive practice with a critical discussion of certain features of recent design and with some forecast of the future. The paper is so long that we can give but a small part of it, even in the pretty copious extracts, which follow:

The man who thinks that a high-speed locomotive should have a stroke not greater than 24 in. is being laid on the shelf, and is never to be taken down until a chance to relate reminiscences is at hand, for the up-to-date man knows that 24 in. has no special virtue. . . .

There are two great causes for improvements in locomotives, and these are acting at present more strongly than ever before. They are the desire to travel fast and to pull heavy trains. The tendency is to increase the tonnage of freight trains, for it is easily seen that several important items of expense are thereby diminished. This is so well understood that it is even unnecessary to state what they are. . . .

In passenger service there are several conditions manifest. One is the desire of the traveling public to move quickly between distant points and to be surrounded with luxury when making such journeys. . . . Another tendency is to have numerous opportunities to travel between the larger towns that are from 25 miles to 50 miles apart. This grows with increasing density of population. Trains for such service are likely to be light. There is also the desire for frequent opportunities for local travel. This may even grow to have the most prominent characteristic of electric street railroad service; viz., single cars at frequent intervals, and to force electricity on steam roads for that kind of service. The use of electricity, however, for main-line service is highly improbable. . . . The efficiency and limitations of electric service are now about as well understood as they can be, and the efficiencies of generators, transmission, and motors are close to a maximum. Further efficiency in electric working of railroads is much more likely to come from improvements in steam engines and boilers (which are not in sight to any great extent), or in the use of gas engines, than in producing, transmitting, and using electricity. If as much encouragement were given by the railroad companies to the improvement of the economy of steam locomotives as has been given by some of them to the improvement of electrical plants, or in changing smokestacks and many other trivial things, the locomotive would probably leave electric traction well behind in economy. . . .

The desire of everybody to be through with a railroad journey will always make demands upon railroad companies in advance of their performances. . . . There are obstacles in the way, of course, and delays come from unavoidable causes, but I think that some causes could be removed. Among others, bad judgment is frequently used by signalmen. I have known signals to be repeatedly thrown against through express trains in favor of unimportant and local trains, causing the express to stop or seriously slow down. . . . The practice of stopping or slowing down trains when other trains are standing at stations has always seemed to me primitive. . . .

In both England and France they are beginning to follow the practice of this country in building larger engines. The Great Northern and Lancashire & Yorkshire are building engines with four-coupled driving wheels, a four-wheel truck forward and a pair of trailing wheels behind. . . . The North Eastern has built some large six-coupled engines with four-wheel leading trucks, being in fact like our regular ten-wheel engines. The North Western is building four-cylinder compounds with two inside and two outside cylinders. The South Western is building large four-cylinder simple engines. two inside and two outside cylinders, and likewise the Glasgow & South Western. The Great Western is building some rather large simple engines, having cylinders 18 in. x 26 in., wheels 6 ft. 8 in. diameter, and the boilers have 1,600 or 1,700 sq. ft. of heating surface. . . .

On the Southern of France (Chemin de Fer du Midi) the locomotives for the highest speed are four-coupled, four-cylinder compounds, and have a four-wheel leading truck. The chief engineer states that they are designed to pull loads of from 175 to 220 tons at 56 miles per hour, and that in August, 1899, they actually hauled 254 tons without loss of time. . . . Six-coupled ten-wheel locomotives, also four-cylinder compounds, are used for loads of 330 tons at speeds of 46 to 50 miles per hour, or, say, equal to loads of eleven 60,000-lb. American cars. . . .

On the Paris & Orleans, the four-cylinder compounds are considered the fastest engines they have, but they have not been found necessary to take the fastest trains from Paris to Bordeaux. They use a four-coupled simple engine carrying 213 lbs. of steam. The driving wheels are 6 ft. 8 in. in diameter, under the middle of the boiler, and a pair of 4-ft. leading wheels, and likewise a pair of 4-ft. trailing wheels. The cylinders are 17½ in. x 24 in., and the heating surface is 1,500 sq. ft.

On the Northern Railroad of France four-coupled engines are used, having two outside high-pressure cylinders 13.4 in. diameter, two inside low-pressure cylinders 20.9 in. diameter, and piston stroke 25.2 in. These have 6 ft. 11¼ in. drivers, 1,890 sq. ft. of heating surface and carry 213 lbs. of steam. The six-coupled engines used on the same road, also four-cylinder compounds, have cylinders 13.8 and 21.6 in. diameter x 25.2 in. stroke. The drivers are 5 ft. 8¾ in. and the heating surface 1,950 sq. ft. The Northern is having built to show at the Exposition two four-cylinder compounds with somewhat larger diameters of cylinders and the same stroke. These will have 2,275 sq. ft. of heating surface and 29½ sq. ft. of grate area.

The high-speed engines on the Paris, Lyons & Mediterranean are four-cylinder, four-coupled compounds, the low-pressure cylinders being inside and the high-pressure cylinders outside. These cylin-

*Extracts from a paper read before the New England Railroad Club at the January meeting.

ders are 13⅜ and 21¼ in. diameter x 24½ in. stroke. They have 2,040 sq. ft. of heating surface and 26.69 sq. ft. of grate surface.

The steam pressure of 213 pounds has been in use in France and Switzerland on simple locomotives for many years.

One is struck by the large number of trains on the French lines that make an average of 50 miles an hour or over, and beyond this we can hardly fail to be impressed by the speeds on the Atlantic City runs. Why, since there are so many fast runs in these lists, have we not a right to inquire why there cannot be faster trains between New York and Boston. . . . It is perfectly practicable to leave Boston at 8 a. m. to arrive in New York at 12 m., and to leave New York at 5 or 6 p. m., and arrive in Boston four hours later. . . .

As I make frequent trips between Boston and Portland I have often wished for quicker timings between those points. By the Eastern Division of the Boston & Maine Railroad the distance is 108 miles, and by the Western Division 115 miles. The quickest time is over the Eastern Division, at the rate of 39.28 miles per hour. On the Western Division there is a train in summer at the rate of 39.65 miles per hour.

I think there ought to be one limited train a day each way between Boston and Portland, to run in not over two and one-half hours, the year round. This would be at the rate of 46 miles per hour on the Western Division, and 43.2 miles per hour on the Eastern Division. A two and one-fourth hour train over the Eastern Division would run at the rate of 48 miles per hour, which is perfectly practicable.

The following is a scheme for a four-hour train between Boston and New York:

Stations.	Distance. Miles.	Time in Motion. h. m.		Speeds. m. p. h.
Boston	0			
Providence	44	0 50	Stop 3 min.	52.82
New London	63.2	1 00	Stop 5 min.	63.20
New York	126.8	2 02		61.88

For such a train as this a powerful locomotive would be needed in order to have ample reserve power for rapid acceleration whenever leaving a station, or after slowing for an adverse signal. As the five-hour trains sometimes have five, six, and even seven cars, it is fair to assume that a four-hour train would be likely to be occasionally increased above its normal weight. At such times the reserve power would be needed.

To fulfil all needs of such service I should recommend a simple locomotive of the following general dimensions:

Diameter of cylinders	20 in.
Stroke of pistons	26 in
Diameter of driving wheels	7 ft.
Grate surface	35 sq. ft.
Heating surface	2,000 sq. ft
Steam pressure	215 lbs.

A two-cylinder compound for the work should have the cylinders 21 in. and 32 in. x 26 in., and otherwise the same as the simple engine.

The Baldwin Locomotive Works write me that they do not regard such a schedule as difficult, and would guarantee to make it regularly with such an engine as they have built for the Chicago, Burlington & Quincy Railroad, which they state would have ample reserve power. This is a Vauclain four-cylinder compound, of the following general dimensions:

Cylinders	13½ in. and 23 in. x 26 in.
Drivers	84¼ in.
Weight, total, about	159,050 lbs.
Weight, on drivers, about	85,850 lbs.
Boiler, diameter	62 in.
Heating surface, total	2,510.7 sq. ft.

Recent Improvements.—Coming to improvements in locomotives in recent years, as before stated, increase in size is very conspicuous.

In boilers, heating surface in passenger engines has increased within a few years from about 1,400 sq. ft. to from 2,000 sq. ft. to about 3,000 sq. ft.

Crown bars have been largely superseded by radial stays, and this has almost necessarily caused the wagon top to be extended sufficiently to allow the dome to be entirely in front of the firebox in order not to interfere with the staying. This incidentally gives an enlarged steam space. Radial stayed boilers, on account of the curvature of the crown sheet and the small area covered by the staying, are found in the western bad water districts to keep very much cleaner than crown bar boilers, and therefore are advantageous. They are lighter than crown bars and assist in reducing weights, which in large locomotives is important. Double riveted base rings are advantageous in keeping the lower joints tight, but it is a matter of regret that they are necessary on account of their weight.

Making fast time depends largely upon the ability of a locomotive to keep up its steam pressure. The pressure of 200 lbs. is unnecessary on simple locomotives as far as economy is concerned, but it is used to some extent. It has the advantage of giving a locomotive great power when wanted, and of course a troublesome low pressure is farther off than with lower pressures.

In watching the changes in locomotives as they grow larger, I have often been struck with the increase in heating surface and the almost fixed area of grate. There is very little to be gained by increasing heating surface unless the grate surface is increased also. What is wanted most of all in large locomotives is more grate surface, for this is the heat-making part of the boiler. More heat is wanted, and nothing but grate area can give it without difficulty and with economy. . . .

Further Improvements.—In looking into the future of locomotive improvements, what are we to anticipate? I have already referred to the increase in size, and this is a prominent characteristic of present and further improvements. It has carried with it many items of better designing and better construction, but it is also an enlargement of defects. The defects of a single valve which has to perform the functions of admission and exhaust for both ends of one cylinder are considerable, but when operated by the ordinary link motion are still more imperfect. These defects have been often stated, and are wire drawing the steam during admission, early exhaust, wire drawing the exhaust, and too early exhaust closure, which, in combination with the wire drawing as the exhaust opening closes, produces an effect equivalent to very early and great compression. The combined result of these defects is to produce a small indicator diagram, which limits acceleration, high speed, and power under all conditions. In consequence of this, locomotives are obliged to have cylinders that are large for the power desired, and which, therefore, are wasteful from several causes, as follows:

First. Increased cylinder condensation.

Second. Extra work to overcome back pressure.

The first is, of course, caused by large cylinder and port surfaces. The second may not be so well understood and will here be dwelt upon. When a piston is moving and one end of the cylinder is open to the atmosphere, the piston expels the steam against atmospheric and back pressures which may have a pressure of 20 to 25 lbs. absolute. The larger the piston the greater the work to overcome this is, and the greater the resulting waste of energy. If, however, the forward pressure could be augmented by making a fuller indicator diagram, the back pressure would bear a smaller proportion to it. Therefore in such a case a cylinder of given size will do more work with a better steam distribution, or a smaller cylinder will do the same work. The results will be greater power and speed possibilities and economy. In future these facts ought to be recognized and taken advantage of. . . . In a word, what locomotive designers ought to pay attention to is the augmentation of the propelling pressure as well as the diminution of the resisting or back pressure. The former has been ignored and the latter has received great attention with small result. Present and future requirements for power and speed demand that attention be given to the former.

On the Paris & Orleans some locomotives have been built with four Corliss valves to each cylinder. . . . There are now quite a number of these locomotives at work, and in a report upon very careful tests of one of them against a slide-valve engine of the same size, it was shown that they save from 9.2 per cent. to 16.25 per cent. of water depending upon the service compared with a slide-valve engine of the same size carrying the same steam pressure. Another engine in one year saved 15.2 per cent. of coal compared with the average of 18 slide-valve engines.

The four-valve engine is faster than the slide-valve engine, and often ran at the rate of 67 miles per hour 18.6 miles, with a train of 184 tons, which the other engine could never do. . . . The common engine did 14,343 foot-pounds of work with one pound of steam, and the four-valve engine 15,721 foot-pounds on the average. The steam pressure of both engines was 142 lbs.

Compound Locomotives.—I now come to the greatest improvement that has been introduced into the motive power department of railroads, viz., the application of the compound principle of using steam to locomotive engines. This is the greatest improvement in such engines that has been made since locomotives were first built, for two reasons; first, because it is the only improvement in principle that has been widely applied, and second, because it is the only fundamental means of economy of fuel and water that can be applied. That it is successful in realizing economy is no more a matter of doubt than that the sun shines. . . . A type of engine that can save nearly one-quarter of the coal now used by simple locomotives; that reduces water consumption by 15 to 20 per cent.; that steams better than simple engines in hard places; that reduces smoke, cinders, and the fire risk; that diminishes boiler and slide-valve repairs, and that does not necessarily increase repairs of any kind, must be adopted as soon as it is intelligently designed and prejudices are relegated to the background. . . .

The question as to the type of compound locomotive is likely to arise frequently, and it can be laid down as a safe belief that the two-cylinder compound is more economical than that having any greater number of cylinders, for the reason that it has the least surface for condensation per unit of piston displacement. In large sizes, however, except for freight service, it is difficult to obtain sufficient port area for the low-pressure cylinder unless a departure is made in the valves from the ordinary practice. In fast work I believe that such engines will not be as economical as we have a right to expect unless a departure is made. The loss of work between the cylinders will counteract the economy to a greater or less extent than is due to the compound principle.

The effect of the compound principle is persistent, and its economical result cannot be prevented except by the introduction of phenomena that come from improper designing. The defect above all to be avoided is the loss between cylinders. The loss between cylinders is so insidious, so to speak, and so little comprehended, that it should be dwelt upon sufficiently to make its causes and nature clear. It cannot be done away with, even in slow-running pumping engines, for even there some work must be absorbed in transferring the steam from one cylinder to the other. In addition to this cause, the various resistances produced by obstructions and abrupt changes in direction of the steam passages are to be noted. The steam in passing out of the first cylinder through the intercepting value, where this is used, and through the open port of the low-pressure cylinder, is considerably retarded, and a loss of pressure is produced. Engines having piston valves suffer from this loss because the steam has to pass through gratings which form the ports. Engines that have the intercepting valve on the low-pressure side are much subject to this loss, because the steam is rapidly drawn from the receiver by the low-pressure piston through this restricted opening. If this valve is on the high-pressure side the steam passes through it only as rapidly as it escapes from the small cylinder, and this is only some one-half to one-third as rapidly as it is drawn into the large cylinder. This shows the importance of placing the intercepting valve as near the high-pressure cylinder as possible.

Having considered this loss, we are in a position to appreciate the reason why certain compound locomotives are highly economical, when working slowly or even moderately fast, with heavy trains. In these cases, in consequence of late cut-offs, yet with considerable expansion and somewhat slow movement of the steam, the losses described are small, and bear a small proportion to the total work done. The result is that the compound is enabled to bring out its valuable qualities undiminished.

Most compound locomotives have a low-pressure port ridiculously small, so small, in fact, that, while simple engines require an extravagant velocity of steam through ports, even as high as fifteen hundred feet per second, some compounds have it two or three times as great. In such locomotives the loss between the cylinders is enormous, and the engine becomes useless for high speeds.

Timber Culture; a Financial Proposition for Railroads.*

The increasing scarcity of timber in the United States has come to be pretty well known; and about one billion dollars' worth of timber is now used up yearly. This being so, every large railroad company has to encounter every now and then the question how it can supply its demands—at least for poles, posts and ties for its own use, by a system of timber culture. The feasibility of this scheme has been fully recognized; but the difficulty was in starting it. The practical operating men had no knowledge of arboriculture and no inclination to acquire it as a further personal accomplishment; and to engage a forestry officer was too radical a feature to add to the already complicated operating machinery.

In spite of these difficulties trials were made by various railroads during the last two decades. The one succeeding best had at the head of the movement a competent horticulturist, and its timber plantations have paid better than almost any other investment that could have been made. About 15 years ago this road planted two sections, 1,280 acres, with Catalpa Speciosa, a tree of very rapid growth and, compared with other timber, almost indestructible in and above ground. The total cost for land, trees, planting, cultivating, overseeing, interest on capital invested, etc., was about $100 per acre, or $128,000; from which the company will realize during the next ten years 1,000 trees per acre, or a total of 1,280,000 trees of from 12 to 18 in. diameter and 30 to 40 ft. high. The trees, being straight and clear of limbs up to a small crown, are excellent material for poles, and estimated worth $2 each standing, or $2,560,000; deducting from this the original total cost, $128,000, leaves the respectable net profit of $2,432,000. Considering these figures and the statistically established fact that about 10,000,000 acres of timber are consumed annually in the United States, 1,000,000 acres by railroads and the balance for building purposes, furniture, wood pulp, etc., we come to the conclusion that it is of paramount importance for railroads, especially those traversing the treeless plains of the West, to inaugurate a systematic timber production; at least for poles, posts and ties, which become so expensive on account of the frequent necessity to renew them.

For those roads which employ a landscape gard-

*This proposition was first made to the A. T. & S. F. Ry, management in my official capacity, but I deemed it important enough to give it publicity.

ener it would be wise to add forest culture to their Landscape Department and produce the timber for ties, etc., along with the ornamental material used for embellishing station grounds. This would save the cost of a separate forestry officer, and the cost of the Landscape Department would be covered by the large profits derived from the Forestry Department.

Forestry is so closely related to landscape gardening that it is impossible for anyone to be a landscape gardener without having a competent knowledge of forestry and its attending operations. The failure sometimes experienced in forest planting can nearly always be traced to some carelessness or incompetency of the planter, either in selecting the soil or the species suited to the climate, or even the distance between the trees, as they should as soon as possible shade the ground in order to keep down weeds and grass and retain the moisture of the soil.

The roads beginning work now in the line above suggested will in a few years be at a vast advantage over those trusting to the future to provide for them; with a comparatively small outlay, the former will have on hand all such material they need at the time when the same will be much scarcer and command nearly double the price of to-day, besides having beautified their station grounds.

Topeka, Kan., Jan. 1900.

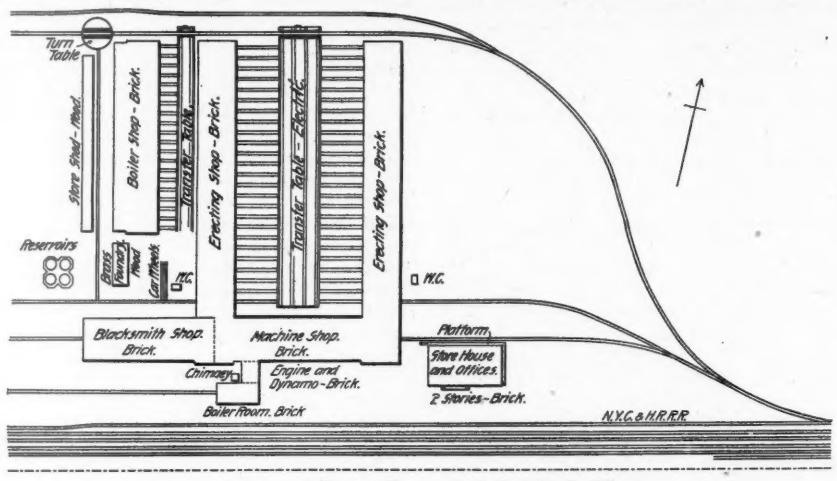
A. REINISCH,
Landscape Gardener,
Atchison, Topeka & Santa Fe Ry.

The Depew Shops of the New York Central.

The shops of the New York Central and Hudson River Railroad at Depew, N. Y., ten miles east of Buffalo, were built in 1892. They were located on an unbroken prairie where ample room could be secured for the necessary buildings and yards. The former were therefore laid out with the view of obtaining the maximum output at the minimum cost, in accordance with the ideas of the officers in charge of the road at the time. The walls of all the buildings are of brick, with roofs carried by iron girders. The main building is U-shaped, with an electric transfer table traveling between the two legs. Connected with and lying west of the base is the blacksmith shop, and north of the latter is the boiler shop. These are the principal buildings on the grounds, in addition to which there is a large store house with commodious offices on the second floor; a small brass foundry, a store shed for iron and castings, and an elevated water tank of four cisterns.

The tools of the machine shop, which forms the base of the U of the main building, are grouped approximately in accordance with the idea of keeping the various types together, though there are exceptions to be found in the case of a few tools that are scattered among others of a class not their own. The general arrangement of the tools is shown in the enlarged scale engraving of the machine, boiler and blacksmith shops. The grouping of the tools and their location, with reference to the economical handling of the work, will be readily seen.

When the shops were erected they were equipped with a miscellaneous assemblage of old tools gathered from the other shops along the line, together



Lay-out of Depew Shops—N. Y. C. & H. R. RR.

with a number of new tools direct from the makers. The former have been gradually weeded out and replaced by modern tools until they have almost entirely disappeared and the shop is filled with those of recent design.

Of such tools nothing need be said, for full information concerning them can be obtained from the builders' catalogue. There are, however, a number of tools in use in the shop that are not listed in any catalogue, but which are products of home talent. They serve to effect a saving in time and labor and are interesting and suggestive. There are also some minor features of locomotive practice, that only come to light as the result of a shop visit, that are worthy of mention.

Compressed Air.

Of course, compressed air is used for the common variety of purposes usually obtaining in such a shop, and the supply is furnished by a compound compressor made on the premises. The air is piped to all parts of the shop. Near the door at the eastern entrance there is a swinging boom carrying an air hoist for handling driving wheels. The swinging end of the boom is carried by lorrey wheels and is driven by a two-cylinder air engine. This engine is of rotary type and is necessarily reversible. The cylinders and plates are of the kind that have been so extensively experimented with in the use of steam. The rotating hubs are set eccentrically with the cylinders and are fitted with a sliding wiper that moves to and fro across the hub as the latter turns. Its position is determined by the position of the hub as its length is equal to the diameter of the cylinder. The shaft carrying the hubs projects out through the casing and carries pinions which mesh with a gear, F. This gear is mounted on a shaft 1⅛ inches in diameter, which passes beneath the cylinder and has, at the other end, a pinion meshing in a rack, by means of which the lorrey is moved to and fro. The method of reversing the engine is clearly shown in the section on the line A B. It consists of the very simple and old method of changing the functions of the exhaust and admission passages. This effect is produced by giving the valve A a quarter turn.

As the parts are shown in the engraving, air is admitted at B and flows through the valve by the port C and thence on to the working parts of the engine by the passage D. After performing its work, it escapes through the passage E., and is exhausted through the port H of the valve A and out at the center G.

If the valve were to be given a quarter turn so that the port I would open into the passage D, then the port C would connect the air pipe B with the passage E, and the motion would be reversed.

The principal advantage of such an engine lies in its small weight and compactness and not in its economical use of air. The latter point being sacrificed on account of the former and the fact that the engine is not in constant use.

A similar single-cylinder engine is used for drilling and tapping for staybolts. This engine is not, however, reversible as the necessity for it does not exist. There is also a small single-cylinder engine, as illustrated, which is used for light work, such as drilling small holes and screwing in of stay-bolts.

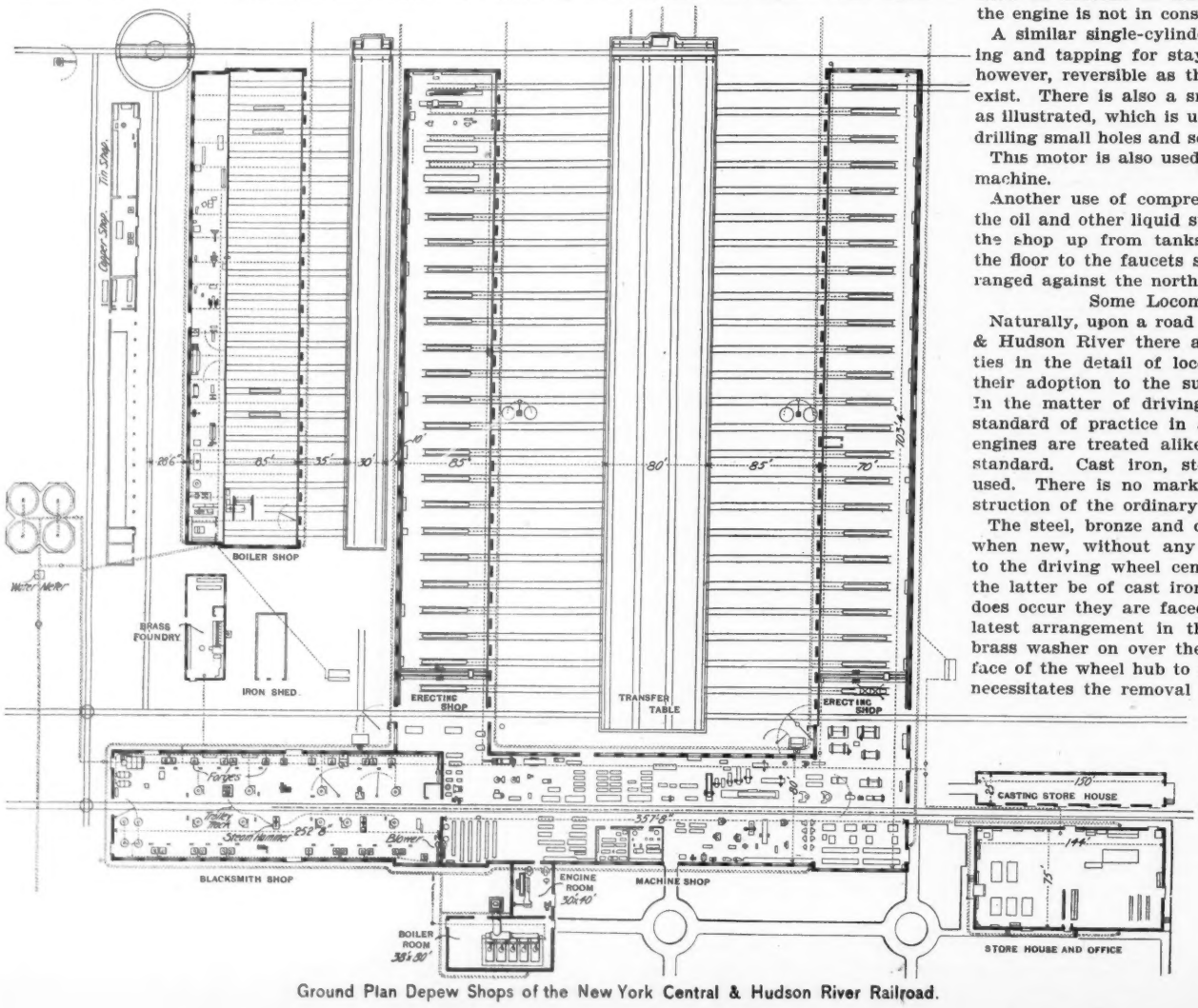
This motor is also used for driving a valve facing machine.

Another use of compressed air is that of forcing the oil and other liquid supplies that are used about the shop up from tanks that are placed beneath the floor to the faucets set above the drip-pans arranged against the north wall of the machine shop.

Some Locomotive Details.

Naturally, upon a road like the New York Central & Hudson River there are a number of peculiarities in the detail of locomotive practice that owe their adoption to the success attending their use. In the matter of driving boxes, while there is no standard of practice in accordance with which all engines are treated alike, there is, nevertheless, a standard. Cast iron, steel and bronze boxes are used. There is no marked peculiarity in the construction of the ordinary box.

The steel, bronze and cast iron boxes are put in, when new, without any protection being afforded to the driving wheel center against wear, whether the latter be of cast iron or steel; but when wear does occur they are faced with a brass plate. The latest arrangement in this line is to put a loose brass washer on over the axle and counterbore the face of the wheel hub to receive it. This, of course, necessitates the removal of the wheel. The bronze or Ajax metal boxes are only used on high-speed passenger engines and are exceedingly heavy and expensive in the first cost. But it is thought that, owing to the value of the scrap, they are no more expensive, in the long run, than those of steel or iron. All boxes, of whatever material they are made,



Ground Plan Depew Shops of the New York Central & Hudson River Railroad.

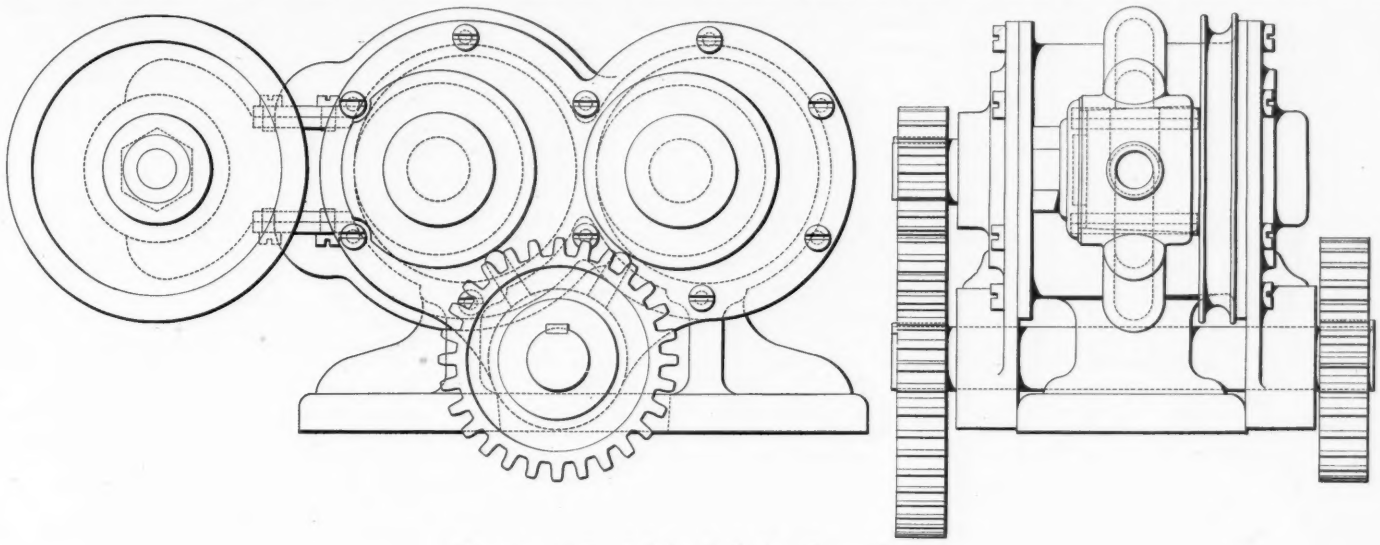
are fitted with crown brasses provided with pockets for babbitt set about 60 degrees apart.

The standard crank pin is made of hammered scrap on the premises. At one time it was customary to case-harden these pins, but so much difficulty was experienced that that practice was given up. The case-hardening naturally warped the pins out of round, and grinding even failed to bring them back to a satisfactory condition of finish and surface. They are, therefore, now merely turned and polished and used for fifteen months, when they are removed from the wheels and discarded, regardless of their apparent condition.

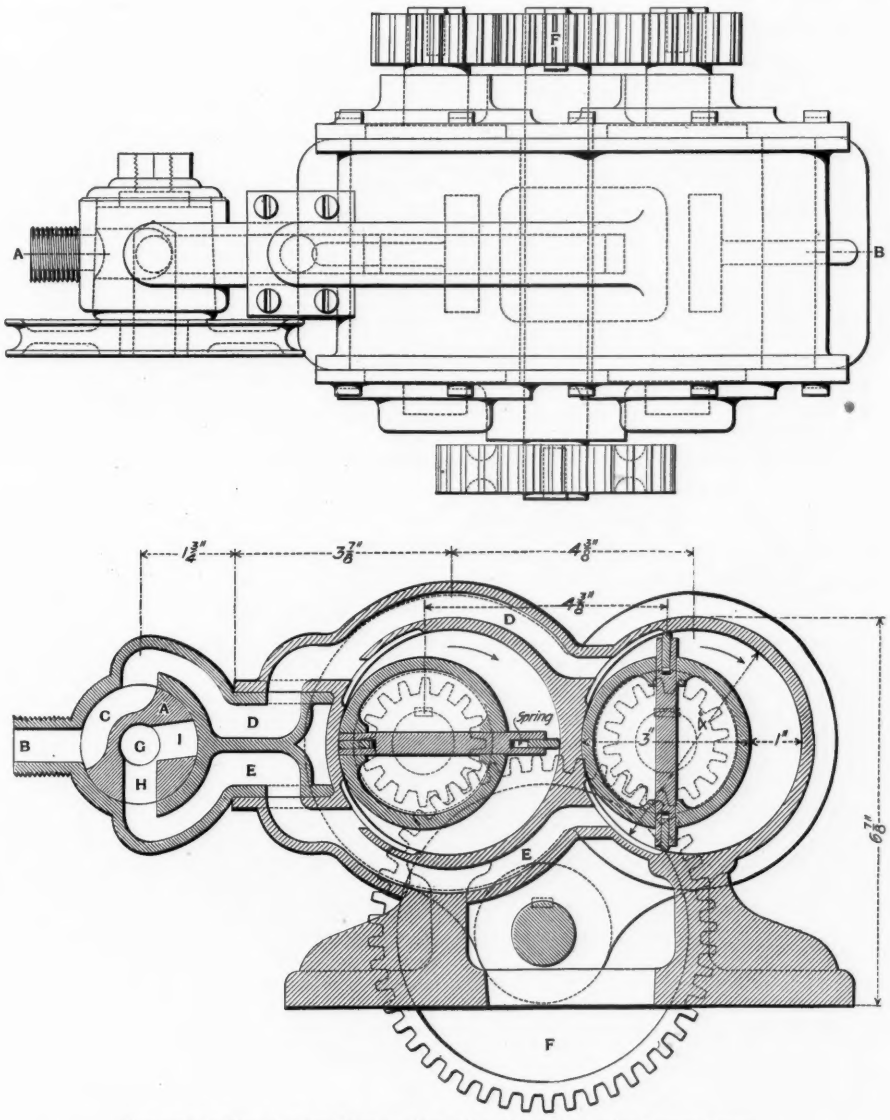
The eccentric is made in halves locked together.

The wheel seat, journal bearing and eccentric seat are all of the same diameter, but the axle is cut away somewhat in the center. The eccentric is held to the axle by a key and two set screws. The method of holding the key in position is to drill a hole about 1 in. in diameter and ⅝ in. deep into the axle and flatten the surface for the bearing of the key. A teat on the key holds it in place while the eccentric is being driven on over it, and prevents it from turning or slipping afterward.

The standard diameter for passenger engine axles when new is 8½ in., and they are removed and discarded when worn to 8 in.



Elevations of Two-Cylinder Air Engine—Depew Shops.



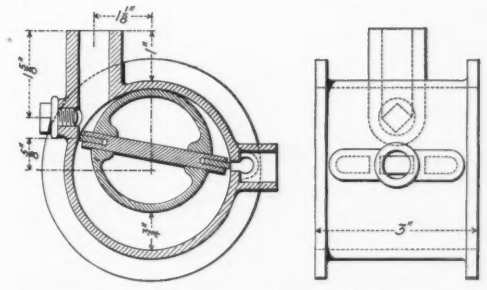
Plan and Section of Two-Cylinder Reversible Air Engine at the Depew Shops.

Special Devices.

Among the devices that have been designed at the shops is a furnace for removing and setting driver tires. It burns soft coal and does its work while the tire is held vertically within it.

Tube welding seems to be a department in which the boilermakers always take an especial pride, and the Depew shops are no exception to the rule. The tubes to be safe-ended are cut off and scarfed, the latter being done with a movable spindle carrying a reamer. The safe-ends are cut off and chamfered by a tool working in a hollow spindle lathe. The tool is shaped with one straight and one beveled cutting edge. The former serves to square the end of one safe-end, while the latter chamfers the end of the next. As the bevel of the tool is the same as that of the reamer, the end fits into the tube and the work of welding is thus greatly facilitated. The heating is done in two gas coke furnaces and the weld made by the roller machine. These furnaces were designed by the boilermaker in charge. After welding, the tubes are filled with water and subjected to a pressure by the admission of compressed air from the shop lines.

One more tool especially deserving of attention is that used for swaging down the tube ends for the reception of the copper ferrule. This work is done in connection with a furnace designed especially for the purpose. The furnace burns gas coke. After swaging, the ends are annealed by being allowed to cool in a bed of charcoal and lime mixed. It has been found that the mixture is preferable to either ingredient alone. Lime acts too slowly and packs into such a solid mass that it requires constant picking in order to loosen it sufficiently to take the tube. The addition of the charcoal makes the mass porous and better adapted to the work.



A Portable Single Cylinder Air Machine at the Depew Shops.

The tubes are simply pushed down into this bed and allowed to stand until cold. With this apparatus one man can heat, swage and anneal five hundred tubes a day. Of course, in a shop of this size there are a number of minor items that have crept in to save labor. One is the utilization of an old drill press to grind packing rings. The ring is held to the spindle by an expanding mandrel and removed and pressed to its work by a lever turning a pinion attached to the table and meshing with a rack on the back of the drill upright.

Another is the adaptation of an old lathe to the milling of quadrants.

Finally, there is a cone-shaped emery wheel on a spindle in the tool shop that is of just the right taper to properly grind bolt-cutter dies when they become dull. The die is held in a clamp on the machine and pressed against the wheel, which then cuts it away in exactly the right place and in exactly the right proportion to accomplish the work that is desired.

In this review of the Depew shops no attempt has been made to go into the details of their management or the methods of caring for the large locomotive equipment committed to their charge, but merely to mention a few salient features that may be of value to those interested in the solution of some of the same problems that are there represented.

Foreign Railroad Notes.

In Germany, near the beginning of the year, an express train ran into the rear of a freight train standing at the station of Bischweiler. The rear car was a tank car filled with spirits, which exploded as the locomotive ran under it. Three men in the mail car were burned alive, and the engineman and fireman so fearfully burned that they soon died. Engine, tender, mail car, baggage car, dining car and three freight cars were destroyed by fire. Misplaced switch. Switchman in jail.

There is a German "Dining Car Company," which has now 27 cars, running chiefly on routes made up of state railroads. On some of these routes it pays something for the privilege, on others nothing; which is probably no more than fair, as there are many routes where the patronage of a dining car hardly pays expenses. This company paid 7 per cent, on its stock for the year ending with September last.

Dr. von Wittek, who recently became the Railroad Minister of Austria for the second time (cabinets are short-lived there), has accepted the presidency of the Austrian Railroad Club, which is perhaps the most flourishing institution of its kind in the world.

RAILROAD GAZETTE

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EDITORIAL ANNOUNCEMENTS.

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to improvements. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

The railroad earnings for January, as shown by the Chronicle, continue the record of gains. Reports from companies operating 99,992 miles show an aggregate gain in gross earnings for the month, in comparison with the corresponding month of 1899, of over $6,000,000. Only 10 of the 109 companies reporting have failed to share in the increase. The ratio of increase is 15.14 per cent. This gain has been made in spite of the falling off in the traffic in grain, and shows that the gain has been due to general traffic. The receipts of wheat at the principal markets this year were less than 11 million bushels in comparison with over 17 million a year ago, and in corn 15 million bushels as against nearly 29 million last year. There was some slight increase in barley and oats, but, taking the five serials, wheat, corn, oats, barley and rye, the receipts for the four weeks were but 42 million bushels this year against over 60 million in 1899. These gains in gross earnings are well distributed throughout the country, representing about $1,200,000 on the trunk lines, $1,000,000 on the Middle and Middle West roads; $1,400,000 on the Northwestern and North Pacific; $1,500,000 on the Southern group, and $700,000 on the Southwestern roads. The New York Central leads the list with $460,000 of increase, and then follow the Louisville & Nashville, $409,000; the Illinois Central, $442,000; the Northern Pacific, $337,000, and the Southern, $336,000.

The American section of the International Association for Testing Materials has a committee (Committee No. 1) at work on what is called in the scheme, Problem No. 1, which is to establish international rules and specifications for testing iron and steel. This American committee is composed of some 20 members, about evenly divided between the manufacturers and engineers. They have been engaged during the past year in preparing average representative American specifications, having divided the materials up into the following classes: Steel for buildings and highway bridges; steel for ships and railroad bridges; steel for boilers; rails, tires, axles, forgings, castings and wire. These specifications will be based on the existing American specifications and best practice in use to-day. The preliminary specifications for each of the above classes of material will probably be printed this winter and distributed for general discussion. This will open up the whole subject of rail specifications and the method of manufacture, and it would be a good time for the railroad companies to discuss the matter with the manufacturers, as has been suggested by Mr. Webster in his paper in this issue. He is the Chairman of this American committee and from his experience as a steel maker and as a consulting and inspecting engineer we may fairly assume that both sides of the subject will get due consideration.

Candy and barn-door hangers can hereafter be sent to Nebraska Cross-Roads as cheaply as to Denver, the Western Freight Association having decided, after listening for a week to the shippers who complain at the new freight classification, to abandon the use of carload rates on these commodities. We suspect that the humor of a Chicago reporter may be responsible for the singling out of these two commodities in the report before us; but the incident will help to show to the complainants what a complicated problem the railroads have before them when they try to meet the demands of thousands of shippers. The objections made at Chicago, like those presented at New York, lay special stress on the comparative reduction in carload rates; and they also make prominent a claim that the withdrawal of carload rates for mixed carloads of two or more different commodities will increase the cost of carriage on important commodities to many places. That the disturbance of Chicago merchants' business is real is shown by the fact that Denver jobbers are already rejoicing at the prospective improvement in their business. Colorado manufacturers, in certain lines, expect to get back the business of some retailers who for years have bought in Chicago. We note that the traffic managers' perplexities do not end with Colorado. Going a step farther, to Salt Lake City, we find a good many people who are glad of a recent advance in freight rates. In a recent issue, one of the papers of that city, referring not to these last changes in classification, but to a number of moderate advances in freight rates from the East, which were made some time ago, says that manufacturing has picked up in Utah at many points, so that a decided increase of prosperity is noticeable in a number of industries. Higher rates have shut out eastern products and the factories of Utah supply the markets. A general increase in prosperity will of course benefit the railroads locally, so that no one can tell until after the test of a considerable period of experience whether the railroads have made or lost money by raising their rates. It is quite possible, of course, that an advance sufficient to entirely kill of a certain branch of traffic from the East may still prove ultimately profitable.

Two explanations have been given as to why the traffic officers of all the principal railroads have increased the difference between certain carload rates and those for smaller quantities of the same goods. The traffic men themselves say that it was to bring the relation of the two rates back to the normal basis which prevailed for many years, until the advent of the severe competition which has been so widespread since 1893. The shippers—or at least one New York representative of shippers—claim that the change is the result of a secret purpose on the part of the railroad men to favor prominent Western manufacturers; to give to these manufacturers a large amount of business which hitherto has been done in Eastern cities. Just at present it seems likely that the difference between C. L. and L. C. L. will have to be adjusted to the demands of business as they now present themselves, and that the question of a normal difference will have to be left out of the discussion. As in hundreds of cases before, the railroads will have to take what they can get, and leave questions of "normal" rates to people who have time to devote themselves to academic discussion. It may be that the changes will favor Western producers, regardless of the motive for making them. Whatever the motive, if any railroad is unduly favoring any large manufacturing interest it will soon find some other road standing up for some other interest, and a compromise will be necessary. Traffic men have not yet become so angelic that they will abandon the time-honored habit of defending the interests of their respective territories.

But there is a third reason for leaving carload rates low while making L. C. L. rates higher. The increasing size of freight cars makes it necessary in some lines of goods to offer stronger inducements to shippers to get them to load cars full. After shipping for years in 10 or 15-ton lots, they are reluctant to ship in 20 or 25-ton lots; indeed they often find it difficult to sell the larger quantity when they could easily dispose of the smaller. And yet it is wasteful for the railroad to send 15 tons in a 25-ton car; and a reduction in rate, to induce the shipment of the larger quantity, is justifiable. We are reminded of this by the statement that the Chicago Freight Committee, on the demand of Armour & Co., has recommended the reduction of the carload minimum on meats from 15 tons to 14. If the capacity of the car is 15 tons (probably in most cases it is more) it is a sacrifice of economy to send a car a thousand miles with less than that quantity. But the demands of shippers will, of course, be irresistible, and if it is not economical to build new cars of moderate capacity, rates will have to be—or should be—made for medium loads; say 12-ton lots in 20-ton cars. Such rates must be lower than for one-ton lots and manifestly ought not to be as low as for 20-ton lots. The manager who is striving for economy by building large cars will do well to keep a watchful eye on his traffic men to see that they do their very best to get large loads.

Passenger Train Speeds—A Study of Some Formulas.

On page 56 (Jan. 26) in connection with Mr. Delano's paper on passenger train speeds, we made an erroneous deduction. Mr. Delano estimates that since the locomotive works with reduced efficiency at high speeds, the coal consumed will be greater than shown by the theoretical formula and may be so great as to vary as the speed. It was said in the paper that the Baldwin Locomotive Works train resistance formula indicated that an increase of speed from 30 to 60 miles an hour would entail an increased fuel consumption of 62½ per cent.; while, on the other hand, judging from data not given in the paper, it was thought that the fuel consumption per car or per ton between 30 and 60 miles an hour increased directly as the speed. Assuming the latter condition, we said in the editorial that the same amount of coal would be burned in running a distance of 60 miles at a speed of either 30 or 60 miles an hour. It can readily be shown, however, that by following the Baldwin train resistance formula, 62½ per cent. more fuel will be consumed for the same train to run a given distance at 60 miles an hour than will be consumed at the lower speed. The following is a simple way of proving this:

By substituting respectively 60 and 30 for V in the B. L. W. formula, $R = 3 + \frac{V}{6}$, we find that the resistance is 62½ per cent. more at the higher than it is at the lower speed, which means that the tractive force must be increased the same percentage for the same train.

Let T be the tractive force and P the I. H. P. at 30 miles an hour, and P′ the I. H. P. at 60 miles. In order to obtain certain ratios it is necessary to obtain an expression showing the relation between the indicated horse-power and the tractive power, and this can be done by the formula, $T = \frac{375 \text{ I. H. P.}}{S}$, where S is the speed in miles per hour. The method of deriving this is explained later. Transposing this equation, we obtain $\text{I. H. P.} = \frac{T S}{375}$, then will

$$P' : P :: \frac{1.625\ T \times 2 \times S}{375} \quad : \quad \frac{T S}{375},$$

from which $P' = 3¼\ P$. Since the speed is doubled, the hours will be divided by two, so that if H. P. were horse-power hours at 30 miles, $\frac{\text{H. P.}'}{2}$ will be the horse-power hours at 60 miles; or the ratio would be 1 : 1.625. The fuel consumption, usually measured by horse-power hours, is, therefore, 62½ per cent. more for the same train and same distance at the higher than at the lower speed.

It may be interesting to show how the formula $T = \frac{375 \text{ I. H. P.}}{S}$ is deduced. As many readers know, Prof. Raymond has used this in his recent discussions in the Railroad Gazette on "Theory of Velocity Grades," and it also appears in Mr. E. H. McHenry's "Rules and Instructions" for the engineering department of the Northern Pacific. The expression for tractive horse-power may be written $T \times V \div 33{,}000$, where T is the total tractive force in pounds and V the speed of the locomotive in feet per minute. Substituting the value of V in terms of S, miles per hour, the tractive horse-power becomes $\frac{T \times S \times 5\,280}{60 \times 33{,}000} = \frac{T \times S}{375}$, which neglecting certain friction losses is equal to the total indicated horse-power (I.H.P.) developed in the cylinders.

An equation can then be written, $\frac{T \times S}{375} = \text{I. H. P.}$ and solving for T, we get the expression $T = \frac{375 \text{ I. H. P.}}{S}$.

The Isthmian Canals.

It is very likely that the fate of the Isthmian Canal treaty will be decided before these words are printed, and therefore we shall not now speculate on the action of the Senate. Those who have read and who remember what the Railroad Gazette has said editorially since January, 1893, on this subject,

know that we have always held that the canal, if built at all, should be built under a guarantee of neutrality, entered into by all the great powers, and that it would be unwise—probably impracticable—to treat the canal as part of the fortified coast line of the United States. Whatever has happened or has been said in the interval has only gone to strengthen this opinion.

The whole matter of the international relations of such a canal is one of immense importance and complication. We should like to see a military report upon it by a board of officers of the army and navy. The opinion of the Navy Strategy Board of our Spanish war would be exceedingly interesting; as would be the opinion of the Major General commanding the army, the Chief of Engineers and the Adjutant General. The opinions of the layman on the military aspect of the matter are worthless, in the nature of things, and are as likely to be wrong as to be right. No doubt the State Department took advice from the military branches of the Government before the treaty was drawn up.

Obviously there can be but one object in the military control of the canal by the United States—an advantage over some enemy in case of war. This, it will be observed, is quite a new consideration. Until the war with Spain the scheme of building the canal and of its control and operation was almost purely commercial; now it appears to be mostly military. This is probably only a temporary overturn of opinion. We judge that within a few years, or even months, we shall again have become a peaceful nation of farmers, traders and manufacturers, and we shall have ceased to long for recognition as a nation of soldiers. Then, we shall again be ready to think of the canal across the Isthmus as an instrument of peace and not of war; as something to be done for the prosperity of the United States and the whole world, not to better fit us to lick someone.

But it is necessary in this wicked world to be able to take care of our own persons and property by physical force. The ability to do so will be the best way of avoiding the need to do so for a number of years yet. Then, would an Isthmian canal, controlled by the ships and forts of the United States, subject to the attacks of any enemy, be a source of military strength or weakness? This is the question on which we want the opinion of the officers of the army and navy, expressed formally and officially, with a due sense of responsibility. There is a great deal to be said on the negative, something of which we have said in times past and which we shall not now repeat. It may be well, however, to call attention to the Oregon argument which now appears so often. First: It is very doubtful if the Oregon would have been permitted to try the canal passage even had the canal existed. This is a subject for the strategists to discuss. Second: The Oregon would not have got through the canal if it had been built on the plans laid down by the Maritime Canal Company and reported on by the Ludlow-Endicott-Noble Commission. Those plans provided for a canal 28 ft. deep. The Oregon ready for sea and action draws 27 ft. No commander of a great warship drawing 27 ft. would think of taking her through 80 or 85 miles of excavated canal with a theoretical maximum depth of 28 ft. The Oregon argument ought to be exposed to the people. The Ludlow Commission recommended that the canal should be 30 ft. deep.

Let us pass for a moment to quite another aspect of this canal matter. It will be observed that the treaty does not use the word Nicaragua, nor does the President in his letter sending the treaty to the Senate. It is "a convention to facilitate the construction of a ship-canal to connect the Atlantic and the Pacific oceans." The President and the State Department could not with sense and propriety negotiate for the construction of a Nicaraguan canal; Congress cannot with sense and propriety legislate for the construction of a Nicaraguan canal. Last March Congress added to the River and Harbor bill an amendment providing for a "full and complete investigation of the Isthmus of Panama . . . of any and all practicable routes for a canal across said Isthmus of Panama, and particularly . . . the Nicaragua route and the Panama route." The munificent sum of $1,000,000 was appropriated for this investigation and a commission was appointed, made up of eminent officers of the army and navy and equally eminent civilians. That commission has taken up the investigation with a proper sense of the great responsibility devolved upon it, and is now on the Isthmus. The report of that commission may be awaited in perfect assurance that it will be thorough, learned, and patriotic. The men who make up the commission have every professional inducement to make it such, and most of them are men of ability and force. Probably their report will be the most conclusive document on this whole canal matter that has ever been produced. How foolish it is, then, to try to force through a Nicaragua canal bill now! We are bound, logically, to suspect the good sense or the good faith of the men who are doing it.

The Royal Commission's Report on Accidents and Freight Car Couplers.

The Royal Commission appointed by the Queen last May to inquire into the causes of accidents to railroad employees, and especially men in the freight train service on the English railroads, has made its report. This Commission, it will be remembered, was constituted as a result of the agitation in Parliament looking to the adoption of automatic couplers on freight cars. Its Chairman is Lord James of Hereford. Secretary Hopwood, of the Board of Trade, came to this country and went back with a virtual recommendation that vertical plane couplers, like those used in this country, be adopted for use on English freight cars; but the law looking to that end, when presented in Parliament, encountered strong opposition from interests in sympathy with the railroad companies; so that finally the proposition that the Board of Trade be authorized to compel the use of improved couplers at the end of five years was rejected and the inquiry through a Commission substituted for it.

The report begins with a statement of the casualties to railroad employees in 1898. By accidents to or in connection with trains and cars 504 were killed and 4,149 injured; and accidents not connected with the movement of vehicles resulted in 38 killed and 8,830 injured; total, 542 killed, 12,979 injured. From these figures there must be deducted the number of men employed by contractors, of whom 20 were killed and 153 injured. The Commission also deducts railroad employees who work in factories; eliminating those and clerks it is found that the number of men employed by the railroads in 1898 was 403,050, of whom 499 were killed and 12,378 injured; average 1.24 per thousand killed, 31 per thousand injured. In the more dangerous employments the statistics show, from accidents to and in connection with trains:

	Employed.	Killed. No.	Killed. Per 1,000.	Injured. No.	Injured. Per 1,000.
Goods, guards and brakemen	14,720	43	2.92	711	48
Trackmen	63,360	122	1.90	204	3.2
Shunters	9,244	47	5.08	616	66

Thus out of the 23,964 freight trainmen 1,327 were injured. If we add to these figures the accidents not connected with the movement of vehicles we have 61 freight trainmen, 16 trackmen and 78 shunters injured per thousand employed in each class respectively.

Fatal accidents to railroad servants were only one-third as many in 1898 as in 1872, but the proportion of shunters killed increased in the four years from 1895 to 1898 from 3.6 per thousand to 5.1 per thousand.

The greatest number of accidents arise from dealings with wagons in motion. Nearly one-half of the freight wagons belong to private owners. Switching and making up trains, which is often done at night in yards not sufficiently lighted, involves coupling and uncoupling frequently when the wagons are in motion. Until about 20 years ago coupling and uncoupling was done by hand, but about that time the use of a pole was introduced and since 1886 this practice has become almost universal. The pole has lessened the risks, but it is by no means perfect, and considerable and regrettable risk still remains. In the night the switchman (shunter) has to carry a lamp in one hand and must run by the side of a moving train to find a fulcrum as best he can on which to rest the pole. Often there is not room in which to manage the pole conveniently. Some wagons have stiff couplings, with which the pole is useless.

The principal relief suggested is the use of automatic couplings. These were suggested as far back as 1874, and in 1889 the Board of Trade proposed action in this direction, but Parliament did nothing. Exhibitions of automatic couplings were held on the London & South Western in 1882 and on the Midland in 1886. Experiments have been made with automatic couplings in Australia, India, France and Austria, but no conclusions have been reached.

The English roads have been on the lookout for an automatic coupling and some are used in passenger trains; but Mr. Hopwood tells the Commission that he is not prepared to recommend any automatic coupling for general use. The report here goes on to relate the experience of the roads in the United States. The Commission is satisfied that the use of automatic couplings here has diminished the number of accidents, but it does not dare to place much confidence in the statistics thus far published, and it is to be remembered that the link and pin couplings of America were more dangerous than the English couplings. The frequency and the sharpness of curves in England (in yards) would interfere with the use of vertical plane couplers.

The conclusion of the Commission is that the railroads of England should not be compelled to apply automatic couplings until further experiments and investigations have been had. The Commission has examined many designs and some appear to have value, but the investigation has not been carried far enough to warrant a recommendation. The railroads should "either voluntarily or by obligation placed upon them, proceed forthwith" to make practical experiments. Models are not sufficient.

The Commission investigated other things besides automatic couplings and recommends:

1. Brake levers to be fixed on both sides of the wagons.
2. Similar labels showing the destination of the wagons to be placed on both sides of them.
3. Abolition of propping and tow-roping as far as possible.
4. That there shall be air or steam brakes on all engines.
5. That all stations or sidings where shunting operations are frequently carried on after dark shall be well and sufficiently lighted.
6. That where point rods and signal wires run across the ground in places where men engaged in shunting operations have to walk and work, such rods and wires shall be sufficiently covered over or protected. And that where points are worked by ground levers such levers shall fall parallel to the lines of rails.
7. That offices, cabins, etc., should, as far as practicable, be so arranged as to diminish the necessity for railway servants to walk upon the line.
8. That there shall be small marks provided to show "the fouling points" for sidings.
9. That the gage glasses shall be so constructed or protected as not, when breaking, to be a danger to the men.
10. That the arrangements for carrying tool boxes, etc., and the placing of the water gages shall be such that the men shall not have to pass over the back of the tender while the engine is running.
11. That the trains shall not be run upon running lines beyond the limits of stations or shunting sidings without a brake van being provided for the guard in charge to ride in.
12. That mechanical means or lookout men shall be employed to protect gangs of men when engaged in relaying the permanent way. That such means shall also be employed when necessary to protect men engaged in repairing the permanent way.

It is believed that the deaths and injuries are unnecessarily great and can, by means of authoritative action, be diminished. The railroads and the car owners do not urge financial questions as objections to the introduction of new apparatus or methods to secure the safety of employees, but care must be taken not to institute any change which will disturb the traffic of the country. How far can the state intervene? In coal mining, in the merchant marine and in factories the state makes regulations for the safety of workmen; and this principle, now generally admitted, justifies state interference in railroad regulation. The Board of Trade has made recommendations to the railroads for many years, but while some companies readily comply with its orders others refuse compliance; and as uniformity is desirable in measures for safety it becomes the duty of the state to secure uniformity. On what grounds can the railroads claim exemption?

The state can put an obligation on the railroads only in one of two ways; either by detailed statutes or by giving power to a department of state (the Board of Trade). If the Board of Trade can inspect the results of an accident, it may, with equal justice, make an inspection in order to prevent an accident. The Board should have power to determine what portions of railroad work are dangerous and to give specific orders in the interests of safety. The railroads should, however, have the right of appeal to the Railway and Canal Commission; and the decisions of this latter tribunal would be subject to revision by the Court of Appeal on points of law.

The Board of Trade, to perform these new functions, should be strengthened by the addition of men of railroad experience.

The Commission recommends that after 10 years the use of freight wagons with inelastic buffers be forbidden; and that railroads be required to report all accidents to employees, whether on the company's premises or on private sidings.

The fact that making up trains "involves coupling and uncoupling when the cars are in motion" means, we take it, that in England, as everywhere else, a trainman or switchman who is in a hurry will take risks which, strictly speaking, are unnecessary. With the English link apparatus cars can be coupled after they have come together and are at rest; and uncoupling can be done under circumstances equally safe. But when work is pressing and time is short, no doubt a saving of time can be effected by not waiting for cars to come to rest. We have had a similar experience in this country in connection with the rule to use a 15-inch stick to guide the link into the drawbar. An expert hand, anxious to avoid delay, grudges the additional time necessary to carry out the rule. And since we have had the M. C. B. automatic coupler in common use we have again seen, in the general experience with uncoupling devices which get out of order or are not kept in good condition, that the disposition among wideawake men to run some risk to save a little time is universal. Perhaps the most salient fact common to both English and American experience, is that only a very moderate percentage of the casualties to freight trainmen is preventable by anything which it is in the power of Legislatures to accomplish.

The force and value of the conclusions of the Royal Commission will depend entirely on what Parliament does with the report. The tabulated recommendations concerning desirable minor improvements will be readily approved by everybody, no doubt, including the railroads. The main point is the recommendation that the railroads be compelled to experiment with automatic couplers. This is not necessarily a radical move, for Parliament could, in carrying out the idea, surround the order with reservations and safeguards sufficient to protect every interest; but some British journals fear that there is danger that action by Parliament may be followed by all the evils of the most rigid and unfriendly Government control of railroads. It is declared that a fresh army of Government inspectors will have to be employed to control railroad working; and that it will be impossible to interfere with a mile or two of line without touching the whole road. There would be no power without responsibility, potent sources of friction, an unlimited vista of expense and no practical good whatever. Previous state interference would be mere child's play compared with the present proposition. Criticising the details of the report, Herapath's Journal wants to know what company should conduct the experiments and where they should be made, also who is to pay the cost. The power of appeal sounds well on paper, but railroad managers are always reluctant to come into conflict with the authorities. Moreover, the Board of Trade has a political chief, and pressure would be brought to bear upon him to extort concessions from the railroads at the instance of trades-union voters.

It is perhaps unnecessary for us to say that any useful comparison of the casualties to trainmen reported by the Royal Commission with similar accidents in this country, is out of the question. The statistics published by the Interstate Commerce Commission give the total number of persons killed and injured in coupling and uncoupling, but they do not separate the passenger service from the freight; and the total due to all causes given in the English report (43 killed) seems to include such accidents as a man being run over by a car, in the same category with fatalities resulting from a derailment or collision.

Readers interested in train despatching will recollect that the question of using the telephone instead of the telegraph for transmitting train orders has been the subject of discussion in the Railroad Gazette a number of times, notably on May 5 last (p. 319), and September 1 (p. 605). Among the roads on which the telephone has been used successfully for this kind of work are the Boston, Revere Beach & Lynn, the Utah & Nevada, the Utah Central and the Illinois Central. On the last named, however, the use of the telephone may, perhaps, be considered experimental, as it was on a line which ordinarily has double track but which was temporarily (for several months) worked single track. This was the busy St. Charles Air Line. The despatching on this line was, however, under the charge of Mr. Annett, who had used the telephone in regular service on the Utah roads above mentioned. We now learn, from a statement in a Pittsburgh paper, that the telephone is used for train orders on the Waynesburg & Washington (narrow gage) road, in Southwestern Pennsylvania, a line 29 miles long. This road is a part of the Pennsylvania System. From the same account it appears that all train orders are sent by telephone on the Scottdale Branch of the Pennsylvania, seven miles; on the Youngwood Branch, 13 miles; and on the South Fork & Scalp Level line, 20 miles long. The last three are subdivisions of the Southwest Pennsylvania, the Pennsylvania's line in the coke district.

NEW PUBLICATIONS.

Railway Engineering. By Cecil B. Smith, Ma. E., late Assistant Professor of Civil Engineering in McGill University, Member of Canadian Society of Civil Engineers. First edition. Toronto and Montreal: Canadian Engineer-Biggar, Samuel & Co., 1899. pp. 197.

The introduction to this book states that it is a foundation course only. One idea of a foundation course is that it shall be of solid and enduring principles, but this is apparently not the idea of the author of this book, for in the first chapter on "Fundamental Considerations," the reasoning in which is largely from Wellington, there are many inaccuracies, and some hasty, unwarranted judgments. For instance: A table is given showing the increase in freight car capacity since 1875, and because the percentage of dead load possible with fully loaded cars decreases from 1875, but remains the same in 1890 and 1896, at about 31 per cent., the opinion is advanced that the limit has been reached. Even before the book was published cars had been built and run that show only 25 per cent. of dead load.

Again, "The great volume of suburban traffic can not be counted on in the future" because of the competition of electric lines. "This is a serious problem for the steam roads to face." In the light of recent operations around Philadelphia, and the Delaware & Hudson Company's suburban changes from Troy, north, and some others, it is fair to say that already the steam road has met the enemy and he is theirs—for the time at least. The article on receipts is so hopelessly in error as to require too much space to straighten it out. It should be entirely rewritten.

In the second chapter, which is mostly from Wellington, and treats of train resistances and their cost, the author falls into two or three of Mr. Wellington's errors, and partially corrects one. The cost of curvature is estimated on the basis of a 90-cent train-mile, while rise and fall is estimated direct from Wellington on a basis of a $1 train-mile, without any mention of the change of base.

Many books of this class are built around some hobby of the author. The hobby in this instance has not been determined, the introduction expressing the hope that the book is well balanced, but there seems to be an undue amount of space given to waterway structures. There are 67 pages, of the whole 197, devoted to this subject, while to track, the next most favored topic, is given but 28 pages, and there is no mention of water supply, yards, or signaling. Two-thirds of the chapter on curves is given to spirals.

In the very short chapter on surveys, and in the articles on abutments and trestles, are some valuable practical suggestions, while the chapter of extracts from the Canadian railroad law is a most commendable feature of the book. Every student of railroad engineering should familiarize himself with general railroad law. So far as we know this is the first work on railroad engineering to touch this subject. Another good feature of the book, too frequently omitted in such works, is an index.

On the whole the scope of the work hardly seems to warrant the breadth of the title.

Eastern Maintenance of Way Association. Proceedings of the Seventeenth Annual Convention, September, 1899. F. C. Stowell, Secretary, Boston & Maine RR., Ware, Mass.

The Proceedings of the last convention of this Association (formerly the New England Roadmasters' Association) make a pamphlet of 124 pages, including the list of members. The scope of the papers and discussions was indicated in the Railroad Gazette at the time of the convention.

The eighteenth annual convention is to be held in Philadelphia. The subjects and committees announced for that convention are: On "Private Crossings at Grade," Henry Ware, Chairman, B., R & P. RR., Springville, N. Y.; "Landscape Gardening," by L. Curtis, B. & M. RR., Lawrence, Mass.; "Handling Snow," A. C. Stickney, Chairman, B. & M. RR., Lowell, Mass.; "Training Section Men," R. P. Collins, N. Y., N. H. & H. RR., Readville, Mass.; "Flangeless Driving Wheels," M. C. Hamilton, Chairman, N. Y., N. H. & H. RR., Hartford, Conn.; Paper, subject to be announced, Walter G. Berg, Chief Engineer L. V. RR., South Bethlehem, Pa.; "Stone Ballast or Gravel Sprinkled With Oil," G. L. R. French, Chairman, B. & M. RR., Salem, Mass. Also a review of the previous year's discussions.

American Institute of Electrical Engineers. Handbook for 1900. Published by the Institute, 26 Cortlandt St., New York. Price, 50 cents.

This handbook of 140 pages has been issued principally for the members of the American Institute of Electrical Engineers. It contains, among other matter, an interesting historical sketch of the Institute, a list of the papers from 1884 to 1899, a classified list of the members, the constitution of the Institute and a report of the Committee on Standardization. It will be sent by the Secretary on the receipt of the above price to persons not members.

Condensers. A Series of Lectures and Articles Reprinted from Power. New York: The Power Publishing Co., 1900. Price 50 cents.

This is a little volume of 80 pages, with index, bound in flexible covers. The subject is treated in a clear and simple way. The theory of condensers is given with some account of their application and economies. The various kinds of condensers used are described and the reader is told how to ascertain the quantity of water required, the method of analyzing and computing the performance of condensing machinery, etc.

Preliminary Income Account, to June 30, 1899: Washington, Interstate Commerce Commission.

The preliminary report of the Income Account of the railroads of the United States, for the year ending June 30, 1899, prepared by the Statistician to the Interstate Commerce Commission, has just been issued. The principal totals of this report were given in the Railroad Gazette of Dec. 8 (p. 42). In the pamphlet now issued the report proper takes up six pages, and the remaining 50 pages contain the tables showing the items for each road.

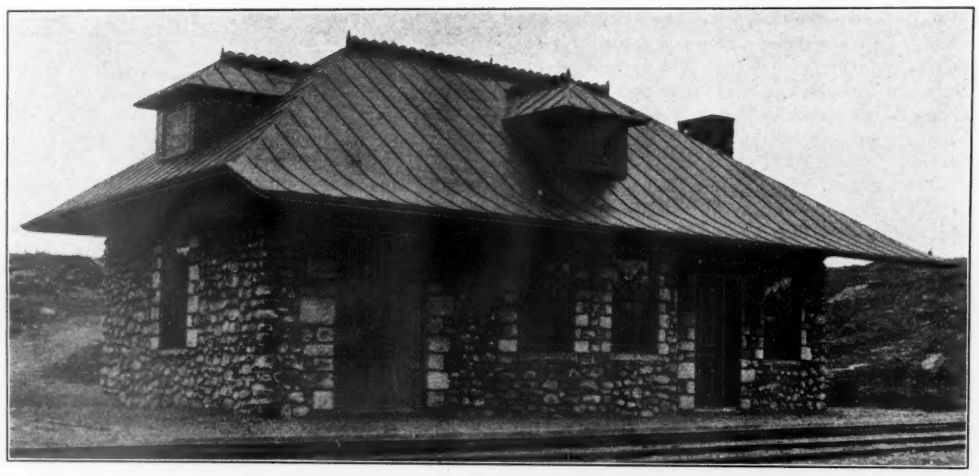
TRADE CATALOGUES.

Air Compressors.—The New York Air Compressor Co., 120 Liberty St., New York City, has established works at Arlington, N. J., and enters the field with a line of air compressors, the purpose being "to meet the requirements of the users of pneumatic power in every way, to produce satisfaction and save money." The company has just issued a pamphlet showing and briefly describing its compressors. These are duplex and single, direct steam driven or belt driven and of all ordinary capacities. A specialty is a vertical belt compressor designed for the operation of pneumatic shop tools and appliances, using pressures up to 100 lbs. Another specialty is a gas or gasoline driven compressor.

Pyrometers.—Messrs. Uehling, Steinbart & Co., Limited, of Carlstadt, N. J., send us a pamphlet describing the pneumatic pyrometers made by that company. These are designed especially for practical every day use in mills, furnaces and foundries, but they are also applicable to testing and laboratory work. A number of excellent letters of recommendation are printed in the pamphlet, together with a long list of important concerns using these pyrometers. Several charts are given showing autographic records.

Passenger Station at St. Joseph's, N. Y.

The Port Jervis, Monticello & New York Railroad has lately built at St. Joseph's, Sullivan County, on the Monticello Division, a handsome passenger station out of material picked up in the neighborhood; that is to say, ordinary boulders. The external appearance of the building is shown in the accompanying engraving. The roof is of tin, painted red, and the platform, or rather the surface around the building which takes the place of a platform, is made of calcareous shale, which is found on the line of this road. The curbstone on the side adjoining the track is 24 in. high. Walks made of this material, after being lightly rolled and used for a few months, become almost as good as a concrete floor. In one respect the surface is superior to a smooth floor, as there is less liability of slipping when it is covered with frost. This building is 20 ft. x 40 ft., and contains, besides the main waiting room, a baggage room and a ticket office. The interior is finished in yellow pine and the total cost of the building was less than $1,200.



Station of the Port Jervis, Monticello & New York Railroad at St. Joseph's, N. Y.

For the photograph from which the engraving is made we are indebted to Mr. A. E. Godeffroy, President of the road.

The Proper Compilation of Statistics of Railroad Earnings.

Prof. Henry C. Adams, statistician of the Interstate Commerce Commission, has written a reply to certain criticisms made several months ago by President Stuyvesant Fish, of the Illinois Central, on the treatment of gross receipts, operating ex-

penses, taxes and net earnings in the annual reports made by Mr. Adams; and this reply is published in a pamphlet which has been issued by the Interstate Commerce Commission. A report of Mr. Fish's article, criticising the statistics of the commission, was given in the Railroad Gazette of Jan. 27, 1899, page 62. Prof. Adams' defense is, in substance, as follows:

The points emphasized in the criticisms of Mr. Fish are as follows:

First. That the earnings of the railways of the United States are overstated in the published reports of the commission.

Second. That taxes should be included in "operating expenses."

Third. That the "preliminary income account" does not agree with the final comprehensive and corrected report.

Fourth. That certain terms used by American accountants are incorrectly used.

Of the above criticisms the important one is undoubtedly the first, which asserts that the statistics published by the commission overstate the earnings of the railways. The table published by Mr. Fish in support of the assertion that the interstate commerce statistics do not properly state the earnings of the railways, is the following:

STATISTICS OF RAILWAYS IN THE UNITED STATES.

[Compiled from Interstate Commerce Commission reports.]

Statement showing the relation of gross receipts from transportation to the earnings of the railroad companies taken as a whole.

Years ended June 30—	Gross receipts from transportation.	Operation expenses paid out.	Taxes paid out.	Rent and interest paid out.	Total expenses paid out.	Excess of gross receipts over total expenses, i. e., *earnings*.	Excess of total expenses over gross receipts, i. e , *loss*.
1890	$1,051,877,632	$692,093,971	$31,207,469	$321,587,465	$1,044,888,905	$6,988,727	.....
1891	1,006,761,395	731,887,893	33,280,095	323,837,635	1,089,005,623	7,755,772	.. ..
1892.....	1,171,407,343	780,997,996	34,053,495	350,222,413	1,165,273,904	6,133,439	.....
1893.....	1,220,751,874	827,921,299	36,514,689	365,389.316	1,229,825,304	.....	$9.073,430
1894	1,073,361,797	731,414,322	38,125,274	361.343,759	1,130,883,355	....	57,521.558
1895	1,075,371.462	725,720,415	59,832,433	354.697,919	1,120,250,767	....	44,879,305
1896 . ..	1,150,169,376	772,989,044	39,970,791	351.065,562	1,164,025,397	.....	13,856,021
1897	1,122,089,773	752,524,764	43,137,844	343,229,868	1,138,892,476	.....	16,802,703
Total..	$8,961,790,652	$6,015,549,704	$296,122,090	$2,771,373,937	$9,083,045,731	.....	$121,255,079

If the above table accurately represents the situation, the statistics published by the commission are certainly incorrect; but a slight consideration of the figures therein presented shows that this table, compiled by Mr. Fish, contains an error in excess of $50,000,000 each year. The error lies in the column headed "rent and interest paid out," which column duplicates expenditures. Mr. Fish charges against "gross receipts from transportation" (the established phrase is "gross earnings from operation") not only the rents paid by operating companies to leased lines for the use of their property, but the interest which leased lines pay to the holders of bonds out of the rentals thus received. To have arrived at correct results Mr. Fish should have increased "gross receipts from transportation" by the amount of rentals paid to lessor companies by lessee companies, or he should have reduced the amount charged as "rent and interest paid out" by the amount of interest which the lessor companies pay out of the rents received by them from the lessee companies. It does not seem necessary to follow out in detail the minor criticisms by which the author of the above erroneous statement seeks to show that the statistics published by the commission overstate the earnings of the railways, for these minor criticisms rest upon the error already pointed out, namely, the error of duplicating expenditures.

. . . Your statistician declines to assume responsibility for so palpable a misuse of published reports. The figures contained in the above table were taken from the summary published annually in the final statistical report, entitled "Summary of expenditures and analysis of fixed charges." This summary appears on page 77 of the report for the year ending June 30, 1896, and on page 76, opposite the table, will be found this statement: "The bold-face type which appears in this summary indicates the expenditures of this class which accrue to subsidiary companies not maintaining operating accounts. It may be that a rent paid by an operating company for the lease of a subsidiary line will appear in the income account of the subsidiary line as interest on funded debt. The aggregate of the figures in bold-face type indicates the extent of this class of duplications."

What more can a conscientious statistician do than to print the duplications which his figures contain in bold-face type, and to call attention in the text to the fact that the bold-face type in the table means a duplication?

Another query presents itself in this connection. Why, you may ask, is it necessary to include in the published reports duplications of both income and expenditures? My answer to this question is that it is the duty of the statistician to collect the facts in the form in which they exist and to compile them as they are collected. The contractual relations by which the railways of this country are organized for operation are very complex. Permit me to give an illustration taken from the experience of this office. Road A, organized as an operating road, was leased to Road B. Road B then leased its property, together with its lease of Road A, to Road C. Road C then leased its property, together with its lease and sublease, back again to Road A for the purpose of operation, so that, in the strict letter of the contract, Road A operates its own mileage under a lease executed indirectly to itself. The statistician cann o modify these contracts. He must keep the accounts straight, notwithstanding the complexities of the contracts. The method adopted by this office is to require a complete report from all railway corporations that maintain an independent legal existence, and that, under existing contractual relations, are used as agencies for the distribution of earnings to investors. And certainly no misapprehension can arise from this method of procedure, provided it is understood that a rental payment by an operating company may be a rental receipt to a financial company, and that when the financial company discharges its interest obligations or declares dividends upon its stock it does so out of the fund which it receives from the operating company. It is a mistake on the part of Mr. Fish to assume that a statistical bureau which deals with all the railways of the United States, operating under complex contract relations, can be guided by the formula of a single, simply organized, operating railway.

The above considerations answer the criticism that the statistical reports of the commission are guilty of "overestimates." Mr. Fish, on the contrary, by his failure to understand these reports, is responsible for underestimates. It is not true, as Mr. Fish asserts, that these reports "utterly confound . . . moneys taken by the railways for transportation with those received by them from (a) each other and from (b) investments, etc." The commission's reports do not confound earnings and income. On the contrary, they separate these two sources of revenue. Indeed, they go further; they classify expenditures in such a way as to enable the elimination of intercorporate payments, on the one hand, and intercorporate expenditures on the other. Has not a statistician the right to assume that his method of solving a difficult problem will be understood before it is subjected to criticism?

Second. The second criticism urged by Mr. Fish pertains to the treatment of taxes. There is no need of answering the implication that taxes are covered and hidden away, for this is not the case. In the report of each carrier to the commission taxes are returned as an independent item, and in the published reports of the commission the total of taxes is independently given. Nor does it seem necessary to explain why taxes are not deducted "before stating profits," for they are deducted before profits are declared. In this criticism Mr. Fish uses nomenclature different from that used by American railway accountants, and by this means leaves an erroneous impression upon one who casually reads his statements.

There is one point, however, relative to the treatment of taxes that can be discussed. The commission in its classification of operating expenses excludes taxes from this class of expenditures. Mr. Fish, on the other hand, claims that taxes should be included in operating expenses. This is no new question. On the contrary, it was discussed for three years before the established rule was adopted. Taxes are excluded from operating expenses in obedience to the following well-established statistical principle, namely: In the compilation of statistical data items which are subject to opposing tendencies should not be classed together. The fact respecting the operating expenses of railways is that proportionally they tend to decrease as the volume of traffic increases; the fact respecting taxes is that proportionally they tend to increase as density of traffic and volume of transactions increase. If, now, taxes be included in operating expenses, the ratio of operating expenses to gross earnings, which is one of the most significant percentages in railway statistics, would be the resultant of opposing forces rather than, as is now the case, the measurement of analogous forces. The position of the commission respecting taxes is correct because it is in harmony with a fundamental statistical principle.

Third. Attention is called, in the third place, to the fact that the preliminary income account presents conclusions that are different from the conclusions presented in the final report published by the commission. This is undoubtedly true, and from the nature of the case this difference must continue. The preliminary report is what it pretends to be—a compilation of the annual reports of such operating roads as are on file at the time the report is published. In view of the fact that the roads which are prompt in making their annual reports are commonly the larger roads, whose operations are dense and whose earnings are relatively high, it must follow that the average earnings per mile published in this report will stand higher than the average earnings published in the final report. It requires considerable ingenuity, however, to be misled by this discrepancy, for, in the first place, this report contains an independent statement for every road whose earnings it includes; and, in the second place, its "summary of earnings," which is made comparative from the year 1892 to the year of publication, gives for each year the mileage covered by the computation. Thus it may be seen at a glance what proportion of the mileage of the United States is made the basis of the preliminary report as contrasted with the mileage made the basis of the completed reports of previous years, with which the computations of the preliminary report are compared.

The policy adopted by this office, in view of the necessary discrepancy between the preliminary report and the final report, has been to urge upon the carriers the necessity of filing promptly their annual reports to the commission. That this policy has resulted in some degree of success is evidenced by the fact that for the year ending June 30, 1898, the divergence between "gross earnings per mile of line," presented in the preliminary report and in the final report for the same period, does not exceed $75.

Fourth. All that remains of the criticisms under consideration pertains to the selection of accounting terms. You certainly cannot desire that I should enter upon an exhaustive discussion of this subject, for such a discussion would be nothing less than a treatise upon the science of railway accounts. Two or three statements, however, may be presented.

The items "gross earnings from operation," "income from operation," "income from other sources" (other than operation), and "net income," have a recognized meaning in American railway accounting. This meaning has been established by practice for a long series of years and has received the approval not only of your commission, but of State railroad commissions. The Association of American Railway Accounting Officers, also, gives its approval to these terms. Such being the case, it would seem to be unwise to consider a revision of these terms or a modification of established custom to meet the desire of a railroad official who appears to be more in sympathy with English than with American methods of accounting; and I do not hesitate to assert that the science and practice of railway accounting has reached a higher stage of perfection in this country than in England.

Even admitting, for the moment, that the nomenclature urged by Mr. Fish is better than that accepted by the American system of accounts, it does not seem that the method he has adopted to secure a change is happily chosen. The success which has attended the administration of the statistical division of your commission in its efforts to establish uniformity in railway reports and in railway accounting is largely due to the assistance which has been rendered by the Association of American Railway Accounting Officers. Every important railway in the United States is represented in this association, and it has become one of the unwritten laws of procedure that any desired change in the matter of accounts should be presented to this association for consideration and advice. Why, permit me to ask, has President Fish not seen fit to present his criticisms, so far as they pertain to the theory of accounts, or to the nomenclature employed, to this association? This was suggested to him when, some years ago, he attacked American accounting through an English publication. In my opinion, it is wise for the commission to continue its policy of reliance upon the advice of this association in all matters which pertain to the details of railway bookkeeping. Whatever renders railway accounting clear, simple, and uniform must result satisfactorily for railway statistics.

It does not seem necessary to extend this reply to cover each and every criticism contained in the letters under consideration. There is some truth in what Mr. Fish says respecting the misinterpretation of what is necessarily the limitation of the preliminary income report. The implied criticism upon the manner in which the phrase "fixed charges" is used in Table IV—B of the final report on railway statistics is perhaps of sufficient importance to cause the elimination of that phrase from the heading of the table. This phrase is not used in the sworn reports of the carriers to the commission, because it has no established meaning. Its use in the published compilations is explained by the necessity of some short phrase to cover the large series of deductions and expenditures analyzed in the table referred to. When I call to mind, however, the many questions that have been presented to me in the course of ten years' correspondence with the accounting officers of this country, I cannot agree with Mr. Fish that

the term "fixed charges" "is universally recognized as including only 'rent' and 'interest'—that is to say, the hire of the land or the money of others."

I am as solicitous as Mr. Fish can be that when "speculation shall culminate in the next panic . . . no recent report by the commission can be quoted as giving color to false values," but I do not admit that an intelligent use of the publications of this office can have so unfortunate a result.

HENRY C. ADAMS.

TECHNICAL.

Manufacturing and Business.

The Cling-Surface Mfg. Co. of Buffalo, N. Y., has just been incorporated in New York State, retaining the same name as heretofore, with Albert B. Young as President and General Manager, and Wm. D. Young, Vice-President and Secretary. The company reports that the past year has been the most prosperous in its history and that the demand for Cling-Surface is increasing steadily. It now has branches in Boston, New York and Chicago, with others just opening in St. Louis and New Orleans. The importing house of W. J. Moxham & Co. of Sidney, Australia, has ordered a large shipment with the exclusive right to handle it in Australia.

H. L. Church, formerly of Church & Getchell, has been appointed representative of the Central Paint Co., of Louisville, Ky., with office in the Baltimore Building, Chicago.

A. J. Coffin has been appointed representative of the Joseph Dixon Crucible Co., with headquarters at 949 Tremont Building, Boston, Mass. He will also have an office with the company at Jersey City. Mr. Coffin will give special attention, in connection with the New England railroads, to Dixon's silica graphite paint and Dixon's pure flake lubricating graphite.

The New York Air Compressor Co. reports sales of over 10 air compressors in as many days. These include a large duplex compressor for Japan and four compressors of 1,200 cubic feet capacity for the Pennsylvania Railroad.

Mr. Edward Brankin, formerly with the National Linseed Oil Company, has been appointed Western Manager of N. Z. Graves & Company of Philadelphia, in charge of the branch office and warehouse at Chicago. This company makes paints and varnish and controls the "mirror-stone" system of painting passenger coaches and locomotives.

The 100 steel flat cars recently ordered by the Michigan Central from the Pressed Steel Car Company will have Thornburgh tandem spring coupler attachments, and the couplers will be fitted with Welch automatic lock lifters. This equipment was furnished by Mr. James A. Ellis, Detroit, Mich.

Mr. John T. Wheeler, formerly in the Purchasing Department of the Grand Rapids & Indiana at Grand Rapids, Mich., has been appointed Purchasing Agent of the Sargent Company of Chicago, with office at 675 Old Colony Building.

J. W. Williams, formerly with the Ewald Iron Co. has been appointed to represent Brown & Co., Incor., of Pittsburgh, in the territory formerly covered by Charles Kennedy, who goes East for the same firm. Mr. Williams' headquarters will be in the Lincoln Trust Bldg., St. Louis.

Iron and Steel.

William Larimer Jones, General Manager of Jones & Laughlins, Ltd., has been made General Manager of the blast furnace plant of Laughlin & Co., Ltd., succeeding J. B. Laughlin, who is now in Italy because of ill health.

Pittsburgh reports state that Henry Phipps, Jr., and John Walker, consulting partners in the Carnegie Steel Co., Ltd., have completed arrangements to buy 300 acres of land along the Monongahela River front near Monongahela, Pa., upon which it is stated a new steel plant will be built.

Application is to be made to the Canadian Parliament for an act to incorporate the Canada Steel Co. with a capital of $18,000,000. The promoters are: F. E. Hinckley, New York; A. C. Pew, Toronto; E. H. Bute, Pittsburg, and H. J. Hardbecke, Kankakee, Ill. The company intends to build works at Welland and Port Arthur, Ont.

M. A. Hanna & Co., according to report, are negotiating for land at Fairport Harbor near Painesville, O., upon which it is proposed to build extensive docks for iron ore.

The Buffalo Steel Co. of Tonawanda has been incorporated in New York State with a capital of $260,000. The incorporators are: Leopold E. Block, Philip D. Block, George H. Jones and John W. Thomas of Chicago; Joseph Block and Emanuel J. Block of Cincinnati, and Jacob, Joseph and John H. Porter of Buffalo.

Another steel plant will soon be established in the Monongahela Valley, near Pittsburgh, Pa. It will be known as the McClintic-Marshall Construction Co. It will do a general iron and steel business. H. H. McClintic, formerly Manager and Vice-President of the Shiffler Bridge Co. and Charles D. Marshall, heretofore Secretary and Engineer of the same company, are the promoters. Both resigned their positions several days ago to engage in the new company. Offices have been opened at 404 Park Building Pittsburgh, Pa.

A. M. Crane, heretofore Assistant General Manager of the American Steel & Wire Co., has been appointed assistant to J. W. Gates, the Chairman of the Executive Committee. The position of Assistant General Manager has been abolished.

The monthly blast furnace statistics, published by the Iron Age, show an increase in the capacity working on Feb. 1 over Jan. 1 of 3,281 tons a week, the weekly product having reached 290,000 tons, exclusive of charcoal iron. Stocks of coke and anthracite pig increased 19,000 tons during the month, which is surprisingly small considering the fact that melters of iron were closed down part of the time.

The price of old steel rails has advanced to $19 at Chicago and $23 at Philadelphia. Old car wheels now bring $24 per ton in Philadelphia and $22 in Chicago.

The Zanesville Iron Co., Zanesville, Ohio, has been incorporated, with a capital of $100,000, to make iron and steel. Among the incorporators are S. B. Wells, A. S. Farber and L. F. Spangles.

The South Bend Malleable Iron Co., of South Bend, Ind., has been incorporated with a capital stock of $75,000 by C. Studebaker, J. M. Studebaker and Edward Y. Mauzy.

W. H. Schoen, formerly Second Vice-President of the Pressed Steel Car Co., Pittsburg, Pa., is now Vice-President, the two secondary offices having been abolished with the retirement of J. W. Dickerson. W. O. Jacquette, formerly Treasurer, has been appointed to fill the new office of Comptroller. A. R. Fraser, heretofore Auditor, becomes Treasurer; H. J. Gerhart, heretofore Assistant Auditor, is made Auditor; Purchasing Agent L. W. Jones has been made Assistant to the President. The purchasing department of the company has been removed to the Wood's Run plant, and the auditing department to the Tradesmen's Building.

Tenders are invited on 400 tons of rails for the Swedish State Railways to weigh 40½ kilos. per metre. Communications should be addressed to Kongl. Jernvagsstyrelsen, Stockholm, Sweden.

The Maryland Steel Co. at Sparrow's Point, Md., has a contract for 5,000 tons of rails for the Norwegian State Ry., to be delivered during the summer.

The Atha & Illingworth steel works at Harrison, N. J., on the line of the Pennsylvania RR., was considerably damaged by fire Feb. 10.

Park Bros. & Co., operating the Park Steel Co., of Pittsburgh, Pa., have bought 100 acres of ground adjoining the recent purchase of 240 acres at West Elizabeth.

The Pittsburgh Dispatch says that practically no changes in the iron and steel situation occurred during the week to Feb. 10. There is a general disposition to wait for further developments, and buyers are placing orders only for urgent use. Prices hold very firm in all lines. Bessemer pig is still quoted at $24, valley, or $24.90, Pittsburgh. Two leading interests are credited with the purchase of 20,000 tons for February delivery at the Association price. No. 2 foundry is held at $23, Pittsburgh and gray forge at $21.50. Southern forge is offered at $20.65, and local forge at $21 to $21.25. Steel is quoted nominally at $35, but there is scarcely enough buying to establish a market.

The Hoboken Shops of the Pennsylvania Railroad.

About six months ago the Pennsylvania Railroad moved its marine shops from the foot of Second street, Hoboken, to new shops at the foot of Tenth street, on the Hudson River. The new shops are very roomy for the work that is to be done in them, and have a particularly neat and orderly appearance. In the old shops the machines were all belt driven, but in the new shops they are all driven by independent electric motors, and an electric crane has also been installed. The aim is especially to secure quickness in repairs in order that no craft shall be out of commission longer than is absolutely necessary. The company's entire New York Harbor fleet of 12 ferryboats and 30 to 40 tugs must depend upon these shops for repairs. Besides the machine shop, the plant includes blacksmith shop, carpenter shop and paint shop. The Sturtevant system of heating and ventilation is used. Exhaust steam is used to heat the air which is blown into the shops.

New Shops for the Philadelphia & Reading.

The Philadelphia & Reading Railway Co. is getting ready to build new locomotive shops at Reading. The plans for the erecting shop are completed and bids have been asked for, and it is hoped that the contract for this shop will be let before March 1. The boiler shop, foundry, blacksmith shop, storehouse, power house, etc., are in preparation, but it will be some time before the plans are ready for inspection.

The plans and specifications for the erecting shop were prepared by Messrs. Wilson Bros. & Co., architects and engineers, of Philadelphia, through whom bids will be taken. This will be 200 ft. x 749 ft. and will be of steel skeleton construction with brick walls. At either end will be an erecting floor with machine shop between. These will be equipped with two electric cranes of 120 tons capacity each and two of 25 tons and one 10-ton crane. It is hoped that this shop will be completed within the year.

Automatic Block Signals on the Reading.

The Philadelphia & Reading has contracted with the Hall Signal Company for the erection of Hall automatic electric block signal on the New York Division between Trenton Junction, N. J., and Bound Brook, 27 miles. This equipment will complete the block signaling of the New York Division; and as the Central of New Jersey is already equipped with electro pneumatic block signals, trains on the whole line from Jersey City to Philadelphia will be run under the space interval. The Hall Company has just finished the equipment of the main line of the Reading with automatic block signals from Philadelphia to Leesport, about 70 miles, and the total length of road now equipped with Hall signals throughout the Reading Company's lines is 211 miles.

Compressed Air Cars in Chicago.

During the severe snow storm in Chicago on the night of Feb. 3, the compressed air cars used as "owl" cars on the North Side were not interfered with by the snow and gave satisfactory service. During the nine months in which these cars have been in service there have been no accidents and they have carried 140,000 passengers.

Dredging Chicago River.

The legal department of the Chicago Sanitary District has decided that the Drainage Board is responsible for the lowering of the Chicago River level, which must be restored, and on Feb. 5 the Trustees of the Sanitary District, under this decision let a contract to Lyden & Drews for dredging the South Branch of the Chicago River to a uniform depth of 20 ft., the work to be done by the opening of navigation next spring. About 3 ft. below the present depth will have to be dredged and about 86,310 cu. yds. of material must be removed. An effort is being made to obtain permission from the city to dump dredgings in the lake front basin.

British Westinghouse Plant.

Mr. Thomas Rodd, Chief Engineer Pennsylvania Lines West, Northwest System, has gone to England with the plans for the buildings of the British Westinghouse Co. at Manchester. We have already given a general description of the works to be built there.

The Shelby Steel Tube Company.

The details are practically completed for consolidating into one company the various plants for making seamless tubes, acquired by the Shelby Steel Tube Co. The new company will have $15,000,000 of capital stock, $6,000,000 preferred and $9,000,000 common. For the present, $5,000,000 in preferred, and $8,150,000 in common stock will be issued. The plants included in the new concern are as follows: Newcastle Tube Co. Newcastle, Pa.; McCool Tube Co., Beaver Falls, Pa.; Auburn Nut & Bolt Works, Auburn, Pa.; Hercules Seamless Tube Co., Garwood, N. J.; Pope Tube Co., Hartford, Conn.; Ellwood Weldless Tube Co., Ellwood City, Pa.; Greenville Tube Co., Greenville, Pa.; American Weldless Tubing Co., Toledo, O.; Brewer Seamless Tubing Co., Toledo, O.; United States Standard Drawn Steel Co., Cuyahoga Falls, O.; Shelby Tube Co., Shelby, O.; Albany Mfg. Co., Albany, Ind. In addition, the company acquires the tubing business of the United States Projectile Co., of Brooklyn, and of the Mansfield Machine Works, of Mansfield.

The directors of the new company are: W. E. Miller, Cleveland, O.; Albert A. Pope, Boston; R. L. Coleman, Chicago; H. A. Lozier, Cleveland; B. J. Williams, Shelby, O.; E. W. Bliss, New York City; L. S. Hoyt, Newcastle, Pa.; John L. McKinney, Titusville, Pa.; F. J. Carolan, San Francisco, Cal.; Frank O. Lowden, Chicago, Ill.; James B. Dill, East Orange, N. J. It is believed that Mr. W. E. Miller, President of the old company, will be made President of the consolidated company, and W. S. Miller, Treasurer. The general office is at Cleveland, O. The new company has been incorporated under the laws of New Jersey. The Shelby Steel Tube Company began business in January, 1891, with a capital of $100,000 to make seamless steel tubes. Under patents and secret processes orginally owned or since acquired the company takes a solid steel billet and draws it into a hollow seamless tube.

THE SCRAP HEAP.

Notes.

Conductors, collectors and brakemen on the suburban passenger trains of the Illinois Central at Chicago have had their wages increased from $80 to $82.50; from $60 to $62.50, and from $50 to $55, respectively.

The Czar of Russia has suspended the import duty on coal for the use of railroads until Sept 1. Considerable quantities of coal have lately been shipped from this country to France, said to be for use on locomotives. Most American coal operators say that orders are so pressing that they can give no attention to inquiries from Europe, though, in consequence of

what appears to be a world-wide scarcity of coal, many foreign inquiries have lately been received.

Train Indicators at the South Terminal Station, Boston.

The following note is from a paper by Mr. Francis, Resident Engineer: Upon a fence, against posts set for the purpose, opposite the ends of each of the 28 tracks, are the train indicators, 6 ft. wide and 9 ft. high, all but two carrying four columns of station names, amounting to about 74 names for each indicator. They also give the track number, name of the road, and the leaving time, and are worked by a sort of interlocking machine. Each train is represented by a card, perforated for all stations except those at which the train stops. This card is inserted in the machine and raised with a lever, moving the rods (except at the perforations), which turns the slats on the indicator. These indicators were made by the Wheeler & Wilson Manufacturing Company, Bridgeport, Conn., and are the largest ever made for the purpose.

Traffic Notes.

The number of interchangeable mileage tickets sold by the Central Passenger Association Bureau in the month of January was 16,684, which is 3,190 more than in the same month of 1899.

The rate on sugar from New Orleans to Denver has been reduced from 77 cents per 100 lbs. to 50. The rate on sugar to Denver from San Francisco, 75 cents, at last accounts remained unchanged.

General Freight Agent W. H. Taylor of the Houston East & West Texas, has been fined by the Texas Railroad Commission $250 for contempt, in publishing a rate on cotton not authorized by the Commission.

The Lower House of Congress has passed a bill making universally applicable the law permitting goods from and to foreign countries to be transported through the United States in bond. Under the law, as now in force, freight from Europe bound for Asia and reaching this country at the port of New York, can be taken through British Columbia with greater facility than through San Francisco.

A New Railroad in Sweden.

The building of a railroad in Sweden, from Elfsio, a station on the State Railroad, to Dalaro, a watering place near Stockholm, may open up another opportunity for American manufacturers of railroad supplies. This line will be 23 miles in length, and the estimated cost, including rolling stock, is $938,000. If Sweden follows her former policy, she will import the most of the rails, rolling stock, etc., and although many of these supplies have come, in the first instance, from the hands of Americans, the United States Consul at Stockholm informs us that comparatively little has come direct from this country, having first been shipped to Germany or England and from there imported into Sweden. Mr. Victor Klemming, Mechanical Director in Chief of the State Railroads, ordered several locomotives from the Richmond Locomotive & Machine Works about a year ago and also placed an order for machine tools with the Niles Tool Works. At that time he paid a visit to several other large American establishments. T. Nordstiom, of Stockholm, is General Director of the State Railroads and F. A. Almgten Director of Rolling Stock and Material.

Promotions and Bonuses on the C. P. R.

Press dispatches from Montreal state that Mr. R. T. Tye, of the Canadian Pacific, who, for the last four years, has been in charge as Chief Engineer, of new construction work in British Columbia, has been promoted to the position of Chief Engineer of Construction, with jurisdiction throughout the Canadian Pacific lines, and has also received a bonus of $5,000 in recognition of the excellence of his work in British Columbia. Mr. J. R. Sullivan, Assistant Engineer, is to be Chief Engineer of the Columbia & Western, and will receive a bonus of $1,000. The division engineers will receive $500 each. Mr. P. J. Dennis is to be made Engineer of Maintenance of Way of the Canadian Pacific.

Power Brake Failures in England.

The last brake report of the British Board of Trade, which is for the six months ending June 30, 1899, shows that 11,693 engines and 49,814 passenger cars have the vacuum brake, and 3,320 engines and 20,525 cars are equipped with the Westinghouse air brake, while 339 engines and 12,151 vehicles have the brakes and apparatus of both systems. Practically all the vehicles have one or the other or both. The report gives no failure of the Westinghouse air brake to act when required. The vacuum brake failed a number of times. In one case, on the Great Central, at Sheffield, a brake failure caused a collision with carriages standing in the station. Other cases of over-running the platform, caused by the failure of the automatic vacuum brake occurred on the Great Northern, the Great Western, the Metropolitan and the South Eastern.

Brooklyn Navy Yard Building Burned.

A fire in building No. 7 in the Brooklyn Navy Yard 2 o'clock Monday morning caused a loss of about $100,000. Of this amount $50,000 is the damage to the building and $50,000 to the electrical apparatus stored on the first floor.

Building No. 7 is a three-story brick structure, 50 ft. in width and 175 ft. long. The offices of the Department of Yards and Docks were on the third floor, and those of the Electrical Equipment Bureau on the second floor. The court-martial room was also on the second floor. On the ground floor was stored a large amount of electrical equipment material.

Chicago Drainage Canal.

Since the opening of the Drainage Canal numbers of ways in which its effect will be shown have been seen. One of the changes is the smaller amount of city water used by large manufacturers. A number of such concern no longer draw water from the city mains.

Corporation Counsel Walker sent a decisive opinion to the city council on Feb. 5 which holds that the city has not the right to make the proposed contract with the Sanitary District for leasing the water power of the Drainage Canal, the terms of which were outlined recently in this column.

In the United States Circuit Court at Chicago February 6 the Board of Trustees of the Chicago Sanitary District filed its answer to the application for an injunction made by the City of St. Louis on January 16 asking that the Drainage Canal be closed. The answer denies that the natural flow of the sewage is into the Chicago River and Lake Michigan, or that the sewage will pollute the water supply of St. Louis, and suggests that St. Louis can connect its intake with the Missouri River above its junction with the Mississippi River at a cost of $1,000,000. The defence also calls attention to the fact that St. Louis failed to make any complaint until the work was completed. It is also stated by the Drainage Board that the canal was opened under a permit from the Governor of Illinois and claims that the water of the Chicago River is purified by natural processes before it reaches St. Louis.

Technical Schools.

University of Illinois.—The State University Bulletin of Feb. 10 is devoted to descriptions of many of the buildings and laboratories in the engineering department of the University and outlines an account of the work in the different courses. A few notes are given on the growth of the engineering college, from which one may obtain a fair notion of the general aims of the different courses. We learn from this that in attendance, the College of Engineering ranks fourth or fifth among the technical schools of the country. Of particular interest is the reference to the railroad mechanical engineering course, which, as we have noted, will have among its equipment a special dynamometer car and a railroad test car, the former to be built by the Peoria & Eastern Division of the C., C., C. & St. L. Ry. and the latter by the Illinois Central Railroad. These railroads will co-operate with the University in building the cars and will be supplied with such results as may from time to time prove of service. The students will thus have an opportunity of making practical road tests. A special feature of the car is the use of oil cylinders in connection with the apparatus for recording the drawbar pull, level of rails, time, distance, etc. The following records will be made or taken in these cars: (a) boiler pressure, (b) steam chest pressure, (c) revolution of drivers per minute, (d) pounds of feed water used, (e) speed of train in miles per minute, (f) drawbar pull in tons, (g) time of passing mile posts, (h) variation of track from gage, (i) variations of each track from surface line, (j) difference of level of track, (k) direction of wind, (l) velocity of wind, (m) air pressure in train pipes, (n) air pressure in auxiliary reservoir. Other observations needed for various tests will be taken as required: for locomotive road tests, indicator diagrams, feed water temperatures, smoke box temperatures, and coal consumption will be taken on the engine; but the use of the car furnishes much information for such tests and provides comfortable and safe quarters for a party of observers. The facilities which these cars give for the study of special problems in this important field will prove of advantage to those students desiring to take up graduate work in this department.

LOCOMOTIVE BUILDING.

The Cuban Steel Ore Co. has ordered two engines from the Baldwin Locomotive Works.

The Lakeside & Marblehead is having one engine built by the Brooks Locomotive W rks.

The Texas & Pacific is, we are unofficially informed, getting prices on 15 locomotives.

The Plant System will order 10 or 12 locomotives provided reasonably early deliveries can be secured.

The Belgian State railroads have asked the Baldwin Locomotive Works and other builders to bid on 30 locomotives.

The Pittsburgh, Bessemer & Lake Erie is reported to be preparing specifications for a considerable number of locomotives.

The Georgia Southern & Florida has ordered one passenger and three freight locomotives from the Schenectady Locomotive Works.

The Birmingham Southern (owned jointly by Southern and Louisville & Nashville) is reported in the market for two locomotives.

The Gulf & Ship Island is said to have increased its order with the Baldwin Locomotive Works, noted Jan. 12, from four to six engines.

The Kansas City & Northern Connecting has ordered one more heavy locomotive from the Baldwin Locomotive Works, making four in all.

The Denver & Rio Grande, it is understood, is about to order 15 consolidation locomotives. On Oct. 20 last we referred to this possible order for engines.

The Chicago, Lake Shore & Eastern will probably order three consolidation and three switching engines from the Pittsburgh Locomotive & Car Works.

The St. Louis Southwestern contemplates ordering five locomotives as noted last week, and we are officially informed they are for passenger service.

The Delaware & Hudson has ordered five more consolidation engines from the Dickson Locomotive Works. They will be duplicates of those of the same class just finished.

The Erie has ordered from the Brooks Locomotive Works the 25 consolidattion engines described in our issue of Feb 2, and has also ordered eight Atlantic type passenger engines from the Baldwin Locomotive Works.

The Lehigh Valley Coal Co. has ordered two six-wheel connected saddle tank locomotives, of 3 ft. gage, with 12 in. x 18 in. cylinders, from the Dickson Locomotives Works. They will be equipped with Hancock inspirators and steam brakes.

The Ohio Southern is talking about ordering one pushing locomotive to weigh 180,000 lbs. for service in handling heavy coal trains on its "Summit Hill," but owing to the difficulty in getting satisfactory deliveries the order has not yet been placed and may be deferred for some time.

The Pittsburgh & Western order for locomotives placed with the Pittsburgh Locomotive & Car Works, and referred to Feb. 2, calls for two compound and four simple engines for April and June delivery. They will weigh 170,500 lbs. with 158,350 lbs. on the driving wheels and have 54 in. driving wheels; straight boilers with a working steam pressure of 180 lbs. and 272 seamless tubes 2¼ in. in diam. and 176 in. long; fireboxes, steel, 121 in. long and 42¼ in. wide and a tender capacity for 6,000 gals. of water and eight tons of coal. The specifications call for Westinghouse air brakes, steel axles, Gollmar bell ringers, Tower couplers, Ohio injectors, U. S. Metallic piston and valve rod packings, Crosby safety valves, American sanders, Nathan lubricators, French springs, Star gages, Latrobe tires and Franklin boiler lagging.

CAR BUILDING.

W. C. Whitney is having one car built by the Pullman Co.

The New England Gas & Coke Co. has asked prices on 150 freight cars.

The Rio Grande Western is having one car for passenger service built by the Pullman Co.

The Mobile & Ohio has ordered 50 Rodger ballast cars from the American Car & Foundry Co.

The Texas & Pacific is reported to have ordered 500 box cars from the American Car & Foundry Co.

The Toledo & Ohio Central Extension may order 100 freight cars. Nothing definite has been decided.

The Philadelphia & Reading has ordered 160 refrigerator cars from the American Car & Foundry Co.

The Kansas City, Fort Scott & Memphis has ordered 200 box cars from the American Car & Foundry Co.

The Belgian State railroads have asked bids on 2,000 freight cars and on some cars for passenger service.

The Northern Pacific is reported as intending to build at its own shops about 400 box cars of large capacity.

The Chicago & Eastern Illinois will, it is believed, let the contract this week for the steel cars referred to Jan. 19.

The Ohio Central Lines have bought for the Kanawha & Michigan 1,000 box cars now in service on another road.

The Pennsylvania Steel Co. has ordered 300 coal cars of 80,000 lbs. capacity from the American Car & Foundry Co.

The Danish State Railroad Department is inviting tenders for 51 passenger, 25 baggage, 11 postal and 400 freight cars.

The New York, New Haven & Hartford is reported as intending to build 100 freight cars of 60,000 lbs. capacity at East Hartford.

The Wabash car order has not been settled. The matter was discussed several days ago by the directors but no definite action taken.

The Seaboard Air Line will order a considerable amount of new rolling stock, including box, coal, flat and stock cars. It is stated that the number will be 3,000.

The Davenport, Rock Island & Northwestern, referred to last week, is about to order eight cars for passenger service and is also figuring on buying some freight equipment.

The Illinois Central has ordered 2,000 box cars of 60,000 lbs. capacity, from the Haskell & Barber Car Company, and will build at its own shops, with materials already on hand, 400 box cars.

The Southern Pacific has ordered 500 Canda double hopper bottom coal cars, 36 ft. long, of 100,000 lbs. capacity, from the American Car & Foundry Co. They are to be delivered in May.

The Chicago, Milwaukee & St. Paul will, as noted last week, build at its West Milwaukee shops 200 cars. We are officially informed that these cars are for the ore trade and will be of 100,000 lbs. capacity.

The American Steel & Wire Co. is about to order 1,000 coal cars, but it has not been decided whether they will be 80,000 lbs. capacity wooden cars or steel cars of 110,000 lbs. capacity. The road will also order 20 wooden flat cars of 80,000 lbs. capacity.

The Chicago, Lake Shore & Eastern has ordered from the Illinois Car & Equipment Co. the 50 gondola cars for private parties noted in our issue of Jan 5. They will be of 80,000 lbs. capacity with pressed steel trucks and bolsters, and will be used by contractors for hauling blast furnace slag from South Chicago.

The Hocking Valley order for 2,000 gondola cars, 1,000 with the Pullman Co. and 1,000 with the American Car & Foundry Co., referred to in recent issues, calls for May and June delivery. In addition to the details previously noted we have received the following official information: The cars will weigh about 34,000 lbs., and be equipped with Buckeye couplers on 1,500, and Tower couplers on 500; French springs on 1,000 and Scott springs on 1,000; Hoey's draft rigging and air brake dust guards; Dayton brake wheels and brake levers; Timms dust guards and Congdon brake shoes. The makes of axles and brasses have not been decided.

The Winchester Avenue electric road, of New Haven, Conn., has ordered four open cars from the Wason Car Mfg. Co.

The International Traction Co., of Buffalo, N. Y., has ordered 100 open cars for April 1 delivery from the J. G. Brill Co., and will buy, later in the season, 150 or 200 more. These are to be used in connection with the Pan-American Exposition.

BRIDGE BUILDING.

ANNNAPOLIS, MD.—A resolution has been introduced in the Maryland Legislature to have a committee report on the safety of the Baltimore & Annapolis Short Line railroad bridge over the Severn.

ARLINGTON, WASH.—The County Commissioners have decided to build bridges over Boulder, Squire and French creeks. Plans for the last two bridges are now complete and specification for one over Squire Creek will be drawn up at once and bids asked.

BEDFORD, PA.—G. W. Cunard, County Surveyor, is one of the viewers on a petition for a bridge over Raystown Branch of the Junietta River, near Ashcom's station.

BOONTON, N. J.—The Delaware, Lackawanna & Western is preparing to rebuild two bridges in Boonton, one over the Morris Canal and the other over the Rockaway River.

BOSTON, MASS.—No appropriation has been made for rebuilding the Broadway bridge across the Fort Point Channel. The matter has not been decided.

A bill was recently introduced before the Board of Aldermen ordering the Finance Committee to include in the first loan bill a sum sufficient to bridge Wordsworth St., over the tracks of the Boston, Revere Beach & Lynn.

BRYAN, TEX.—A bridge is wanted over the Nanasota River at the old Ferguson crossing, between Brazos and Gines counties.

CAMPBELLTON, NEW BRUNSWICK.—Mr. W. Rigsley of this place is applying for a Dominion act to allow the Restigouche & Western Ry. to build a bridge over the St. John River from a point between Grand Falls in the County of Victoria, N. B., and Edmundstan in the County of Madawaska.

CHAMBELAIN, S. D.—The Sioux Falls & Pacific, said to be an auxiliary line of the Chicago, Milwaukee & St. Paul, will build a high bridge over the Missouri River at Chamberlain.

CHICAGO, ILL.—The City Council has ordered the sale of the old Taylor St. bridge.

The Trustees of the Sanitary District have stopped work on the new bridge at Taylor St. as the city is considering closing the street in connection with the track elevation of the C., R. I. & P. and the L. S. & M. S. roads. The substructure of the bridge is completed and $10,000 has been spent on the abutments, but nothing has been done on the superstructure, which was to cost $75,000. If it is decided not to complete the bridge at Taylor St. it is expected that a bridge at some other point to be designated by the city, will be built by the Sanitary District.

CLEVELAND, O.—The Mayor has suggested a new viaduct in place of the present Superior St. viaduct over which it is proposed to continue a boulevard.

The Big Consolidated St. Ry. Co. has decided to abandon its tracks in Lake Front Ave. in East Cleveland, and to connect the line on Hayden Ave. with the Euclid Ave. line by a bridge and trestle from the Windemere barns. This will avoid the grade crossing of the Nickel Plate on Lake Front Ave.

COHOES, N. Y.—The State Railroad Commissioner has been considering improvements at the High St. crossing, Cohoes. An overhead bridge is proposed.

CONNELLSVILLE, PA.—We are informed that citizens of Connellsville and New Haven are endeavoring to have the present bridge over the Youghiogheny River made a free bridge, and also that there is talk of building a new suspension bridge between the two towns.

DRAYTON, N. D.—The U. S. Senate has passed a bill authorizing a bridge built across the Red River of the North at Drayton.

DULUTH, MINN.—The Supreme Court has ordered a new viaduct built over Garfield Ave. by the St. Paul & Duluth, the Northern Pacific and the Duluth Transfer Ry. Co. The Transfer Co. is required to build 319 ft. of the bridge and the other two companies together 1,500 ft.

The Duluth, Missabe & Northern have let contracts to the Keystone Bridge Works for a 200-ft. double track plate girder bridge over Keens Creek; also for a viaduct in Duluth over the streets and railroad tracks in approach to ore dock No. 3. The latter is a double track steel plate girder bridge 447 ft. long. The work is to be completed by May 1.

ELGIN, ILL.—The plans being prepared for the two new bridges over Fox River will be ready in about 30 days. There will be a girder bridge 270 ft. long, of three spans each 90 ft. long. The other bridge will be a low truss, 300 ft. long, of three equal spans. A. G. Riter, of Chicago, is the Engineer; Wm. F. Sylla, City Engineer.

ELKTON, MD.—Viewers have been appointed to consider a site for a proposed bridge over Little Elk Creek, Cecil County.

GLENWOOD, PA.—Regarding the report that the Baltimore & Ohio will rebuild the bridge over the Monongahela River at Glenwood, we are informed that it is quite possible that within the next year it will be considerably strengthened in order to handle the heavy engines to be used on the Wheeling & Pittsburgh Division.

HARRISBURG, PA.—The Pennsylvania has for some years been making repairs yearly to the McClay St. bridge, Harrisburg. A portion of it has been rebuilt and the work will be continued until all of it is completed.

KANKAKEE, ILL.—Bids are wanted until March 2 by the City Engineer for a concrete bridge 593 ft. long, of six spans, across the Kankankee River at Washington St. The total estimated cost is placed at $40,000. Robert D. Gregg, City Engineer.

LEBANON, TENN.—We are informed that this town contemplated building an iron or steel bridge over the town creek, but circumstances have arisen since which has caused the plan to be abandoned for the present. H. L. Coe, President of the town.

LEWISTON, CAL.—H. C. Ingram, Surveyor of Trinity County, has been authorized to prepare plans and specifications for a proposed steel bridge across Trinity River, at Lewiston, bridge to be a single span of 180 ft.

LINDEN, PA.—A bridge is wanted over the west branch of the Susquehanna River at or near Linden, Lycoming County. The County Court has been petioned.

MALVERN, ARK.—The Bridge Committee of Hot Springs County will let a contract at public outcry at 2 P. M., March 6, for an iron or steel bridge over the Ouachita River at a point known as Rockport, two miles northwest of Malvern, the bridge to be three spans, having a total length of 510 ft., with 16 ft. roadway and three piers, one abutment for same 20 ft. of pile trestle approach and about 30 ft. of dirt fill. J. M. Caldwell, David S. McCray, Wm. Lambert, Bridge Commissioners.

MANCHESTER, N. H.—In the matter of a new overhead bridge above the tracks of the Manchester & Lawrence RR. at South Elm St., we are told that the city, the Boston & Maine RR. and the Manchester St. Ry. Co. are interested. A conference of these parties will be held soon to agree upon the apportionment of the expense. The proposition is to build a steel bridge 60 ft. wide, replacing the wooden one.

MONTGOMERY, PA.—A county bridge has been petitioned for across the Susquehanna River at Nisbet.

NASHVILLE, TENN.—The Board of Public Works has sent a bill to the City Council asking for an appropriation for a bridge on Hudson St. near the plant of the Nashville Hosiery Co.

NEWAYGO, MICH.—The lower bridge spanning the Muskegon River at this place was destroyed by high water Feb. 9. This structure cost $12,000.

NORWICH, CONN.—The New York, New Haven & Hartford will probably rebuild the bridge over the Shetushet River.

ORANGE, N. J.—The Wrought Iron Bridge Co. has the contract for the iron bridge over the dam at Campbell's pond.

OTTAWA, ONT.—According to report, the City Engineer has suggested a new bridge on Elgin St. across Patterson's Creek. The present bridge is of wood.

PAWTUCKET, R. I.—The plans for the proposed drawbridge over the Seekonk at East Providence provides for a ship channel 80 ft. wide.

PHILADELPHIA, PA.—The sub-committee on Bridges of the City Council's Committee on Surveys recently considered the site of the bridges proposed across Frankford Creek on the line of Wyoming Ave. and Frankford Road.

PORT ARTHUR, ONT.—Hector Baxter of Minneapolis, Minn., is reported to be the representative of the Minnesota & Ontario Bridge Co., which proposes to build a railroad bridge across Rainy River for the Port Arthur, Ontario & Western RR. It was recently stated that this bridge would cost about $200,000. The consent of the Canadian Government has been obtained, according to report.

REXBURG, IDA.—A proposition is under consideration for a bridge over the north fork of Snake River on the County road running north from Rexburg.

SEATTLE, WASH.—The Seattle Electric Co. will build a new trestle for the Ballard Division line and will also rebuild the trestle for the railroad at Salmon Bay. A permit has been granted for this work.

SELIN'S GROVE, PA.—Reports state that the A. & P. Roberts Co. has the contract for the new wagon bridge across the Susquehanna River from Shamokin dam to Sunbury, which is to be an iron structure on 11 piers, and will cost $140,000.

SCHENECTADY, N. Y.—The General Electric Co. has petitioned for a liftbridge over the Erie Canal at Washington St. N. J. Marlette, Secretary of the Board of Water Commissioners.

SCRANTON,— PA.—The Lackawanna Railroad has offered to pay $25,000 toward the cost of the West Lackawanna Ave. viaduct.

SHREVEPORT, LA.—A bill has been passed by the House of Representatives authorizing a bridge across Twelve-mile Bayou near Shreveport, by the Texarkana, Shreveport & Natchez Ry. Co. At the option of the railroad company this bridge may be used for wagons and other traffic.

STOCKTON, CAL.—A report says the City Surveyor will probably soon be authorized to prepare plans and estimates for two steel bridges across Miner Channel, one at Grant and the other at Auroa St., and a wooden bridge across North St. canal at El Dorado St.

SUNBURY, PA.—The Board of Directors of the Philadelphia & Erie RR. Co. have set aside $75,000 for new bridges this year. On the line from Sunbury to Erie there are a number of wooden bridges which will be replaced by steel or stone.

The grand jury has approved the report of the viewers for a joint county bridge over Big Roaring Creek at Bear Gap.

TARBORO, N. C.—The United States Senate has passed a bill authorizing a railroad bridge across Fishing Creek, Edgecombe County, N. C.

UTICA, N. Y.—The highway bridges over the Mohawk River at Genesee St., and also at Park Ave. have been condemned. The Park St. structure has been closed. New bridges are wanted at both places. The present bridge at Park Ave. is a two-span iron bridge—one 114 ft. long and the other 94 ft. The roadway is 16 ft. wide. Paul Louis Schultze, City Surveyor.

WASHINGTON, D. C.—The Washington & Great Falls Electric Ry. has let contracts to the Youngstown Bridge Co. for the superstructure, and contracts to the J. G. White Co. of New York for the foundations of the iron bridges which are to replace the wooden trestles on the Suburban Road in the District of Columbia and Maryland. The bridges vary in length from 50 ft. to 100 ft.

By order of the Secretary of War, Brig. Gen. Wilson, Chief Engineer, U. S. A., Washington, D. C., has appointed a board of officers of the Corps of Engineers to consider and report upon House bill No. 1,065. The board is "to authorize the construction of bridges across the Ohio, Monongahela, Mississippi, Great Kanawha, Tennessee, Cumberland and the the Illinois rivers, and to prescribe the dimensions of the same." The board consists of Lieut. Col. Milton B. Adams, Nashville, Tenn.; Maj. Charles F. Powell, local government engineer; Maj. Joseph H. Willard, Chicago, Ill.; Maj. William H. Bixby, Cincinnati; Maj. Dan. C. Kingman, Chattanooga, Tenn.; Capt. Harry F. Hodges, Cincinnati, O., and Capt. Edward Barr, St. Louis, Mo. The board will assemble at Cincinnati upon the call of the senior member.

WILLOW POINT, N. Y.—The Elmira Bridge Co. has a contract from the Delaware, Lackawanna & Western at $180,000, for a new bridge over the Susquehanna River at this place.

Other Structures.

AUGUSTA, GA.—Reports state that plans have been ordered prepared by the Georgia RR. for a new station for Augusta.

BALLSTON, N. Y.—The Delaware & Hudson will build a new passenger station at Ballston.

BANGOR, ME.—Surveys are reported made and plans ordered prepared for a new freight and passenger station for the Maine Central.

BIRMINGHAM, ALA.—The Louisville & Nashville has let the contract for its new office building in Twelfth St. to Cook & Laurie of Montgomery. The building will be two stories high, and front 60 ft. on Twentieth St., running back 50 ft. and adjoin the freight depot.

NEW YORK, N. Y.—The plans for the New York Custom House building which were designed by Mr. Cass Gilbert, will be on exhibition from Feb. 10 to March 3 in the galleries of the American Fine Arts Society, 215 West 57th St.

NICETOWN, PA.—The Midvale Steel Co. will build a storage warehouse on the line of the Philadelphia & Reading.

PHILADELPHIA, PA.—Ryan & Kelley, contractors of Philadelphia, have a contract to build a new pier on the Delaware River south of Snyder Ave. to cost about $250,000. The shed will be 130 x 585 ft.

PITTSBURGH, PA.—The National Tube Co. has plans for a new plant to be built at Christy Park at a cost of about $300,000.

The contract for building the extension to the plant of the Westinghouse Electric & Manufacturing Co. at East Pittsburgh has been let to W. F. Trimble & Sons of Allegheny. The extension will be 116 x 76 ft., and cost about $400,000, and must be finished within four months after the steel work is delivered.

The Pennsylvania has bought all the ground needed for the new Union Station at Pittsburgh. The demolition of the old buildings is begun. Messrs. D. H. Burnham & Co., Chicago, Ill., are the architects.

A site has been decided upon by the American Axe & Tool Co. upon which to centralize the various plants of the company, and negotiations are pending for about 100 acres of land on the Ohio River, near Steubenville, O.

ROCHESTER, N. Y.—We are told that the Lehigh Valley RR. does not expect to do further work with the new station at Rochester, N. Y., the foundations for which are already in place.

ST. CLOUD, MINN.—The Great Northern, according to report, is considering building an extension to the engine house.

SCRANTON, PA.—A new armory building for the Thirteenth Regiment, Pennsylvania National Guard, will be built at Scranton at a cost of $140,000. It will be 336 x 170 ft.

TORONTO, ONT.—The Richelieu & Ontario will build a large wharf at the foot of Scott St., in Toronto, to cost $23,000; it will be 357 ft. long and 54 wide.

WICHITA, KAN.—Reports state that plans are being made by the Missouri Pacific for a new depot for Wichita.

WINNIPEG, MAN.—It is stated that the Canadian Pacific has decided to rebuild the burned station and hotel here at a cost of $1,000,000.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xii.)

Northwestern Electrical Association.

The committee appointed by President Norcross to make arrangements for the Summer Convention at Waupaca, Wis., met in Chicago, Feb. 3, and decided on June 26, 27 and 28 for the meeting.

Western Railway Club.

At the regular meeting to be held at the Auditorium Hotel, Tuesday afternoon, Feb. 20, Mr. C. H. Quereau, Assistant Superintendent of Michinery, Denver & Rio Grande, will present a paper entitled "Ton-Mile Statistics." A second paper, "Suggestions for the Revision of the M. C. B. Rules for Loading Long Material," will be presented by Mr. F. H. Stark, Master Car Builder of the Cleveland, Lorain & Wheeling.

The Civil Engineers' Society of St. Paul.

At the regular meeting of the society, Feb. 5, Mr. C. F. Loweth read a paper on Moving Horizontally a 361 ft. Railway Bridge Span with Oak Wedges. Mr. A. H. Munster described his experience in raising heavy weights with wedges. To cite one case: A steel tower 130 ft. high, supporting deck spans and resting on masonry pedestals, two of which had settled. To plumb the tower thin steel wedges, 42 to a pedestal, were alternately driven and skimmed by eighths of an inch, thus lifting about 300 tons an inch and a half without damage to bridge, masonry or wedges. The wedges were 18 in. long, 3½ in. wide, rising ⅜ in. in 12 in., and were forged under steam hammer from locomotive springs taken from scrap heaps.

Southern and Southwestern Railway Club.

The regular quarterly meeting of the Southern & Southwestern Railway Club, will be held at the Kimball House, Atlanta, Ga., at 10 o'clock A. M., Thursday, April 12. The following subjects will be discussed:

To what extent is it practical and economical to Patch Locomotive Fire-Boxes for Coal or Wood Fuel? Special Committee—Messrs. E. Burton, F. H. McGee and W. H. Thomas.

Cost and Efficiency of Treating Timber used in Engine and Car Construction, with all data as to process, material used, etc. Special Committee—Messrs. W. E. Symons, W. H. Thomas and Pulaski Leeds.

M. C. B. Rules Recommendations. Special Committee—Messrs. J. M. Holt, F. H. McGee and J. W. Robider.

Progress of Abating the Smoke Nuisance of Locomotive Engines. Special Committee—W. L. Tracy, F. H. McGee and W. H. Owens.

The Relationship between the Mechanical and Operating Departments of Railroads and the best methods of promoting harmony between the two, to the end that the highest possible efficiency be attained.

The Engineers' Club of Philadelphia.

A business meeting of the club will be held on Saturday, Feb. 17, at 8 o'clock p. m., at which time the amendments to the by-laws, offered at the meeting of Jan. 20, will come up for discussion and possible amendment, and will then be in order for final action on March 3d. The paper for that evening is: "The Canadian Pacific Railway from Laggan to Revelstoke, British Columbia," by William S. Vaux, Jr. It will be illustrated.

At the meeting, Feb. 3, Prof. A. C. Abbott (visitor) made an address upon the subject of the "Utilization

of Bacteriological Methods in Modern Sanitary Engineering." He gave a description of nature's method of filtering water and sewage through the soil, and showed how this has been applied and improved upon by the engineer in artificial filtration. The bacteriologist has taught the engineer, however, that in sand filtration the sand is simply a framework to support the filtering material, which consists of a gelantinous felt formed by the collection of microorganisms. The modern method of sewage purification by septic tanks and coke filters was dwelt upon in detail with blackboard illustrations.

PERSONAL.

(For other personal mention see Elections and Appointments.)

—Lieutenant-Colonel W. H. H. Benyaurd, who for the last seven months had been in charge of the New York Harbor improvements, died Feb. 7. He was born in Pennsylvania fifty-nine years ago, and was graduated from West Point in 1863.

—Thomas M. Turner, died at his home in Ellis Park, Ill., Feb. 5, aged 71 years. He went to Chicago in 1854, and was occupied there and at Bloomington, Ill., as an engineer in the building of the Chicago & Alton road and its Bloomington shops, and was afterward Roadmaster of that road.

—Mr. Andrew Reasoner, whose resignation as Superintendent of the Morris & Essex Division of the Delaware, Lackawanna & Western, was noted in our issue of March 31, 1899, died at his home in East Orange, N. J., Feb. 9. A brief sketch of Mr. Reasoner's life was given in our issue of March 24 last year.

—Capt. David M. Cochrane has been appointed Superintendent of the Goodrich Transportation Co., of Chicago, to succeed Capt. John W. Gillman, whose death, on Jan. 31, was noted last week. Capt. Cochrane has been in service on the Lakes for 40 years, much of the time in command of steamers of the Goodrich Line. He will also succeed Capt. Gillman as a director of the company. The appointment was effective Feb. 6.

—Mr. Geo. H. Norman, a well known constructor of public works, died at Palm Beach, Fla., Feb. 4. He was born in Newport, R. I., Jan. 1, 1827. Through his efforts the Newport Daily News was founded in 1846. He was largely interested in the building of gas, water and other municipal works in many cities in New England and the Middle States. He was elected a member of the Society of Civil Engineers Sept. 17, 1869, and in 1874 founded the Normal medal, which is annually assigned to the best paper read before the Society.

—Mr. W. J. Underwood, who succeeds Mr. R. H. Williams as General Superintendent of the Chicago, Milwaukee & St. Paul, was born at Milwaukee, Wis., in 1852. He was employed as brakeman and conductor from 1872 to 1874. For two years following 1884 he was Superintendent of the Sioux City & Dakota Division; from then until 1894 of the River Division; then for two years as Assistant General Superintendent of the Middle Division located at Milwaukee. From 1898 until his recent promotion he was Assistant General Superintendent of the Northern District at Minneapolis.

—Mr. Ira A. McCormack, who in October last resigned as General Superintendent of all the lines of the Brooklyn Rapid Transit Co. to accept the office of Managing Director and Vice-President of the Syracuse (N. Y.) Rapid Transit Railway Co., will leave the latter place on the appointment of a successor, to become General Manager of the Cleveland (O.) Electric Railway. The history of Mr. McCormack, who served in various places on steam railroads for twenty years, is known to our readers. In our issue of May 12 last we published a synopsis of his railroad work.

—Mr. W. B. Denham who became General Superintendent of the Plant System on Feb. 1, was born March 1, 1849, at Monticello, Fla. He was graduated at the Virginia Military Institute in 1879, and took a post graduate course of Civil Engineering the following year. He then entered railroad service as Assistant Engineer of the Wilmington, Columbia & Augusta. He was express messenger of the Southern Express Company for about six years, then for two years until 1884, Civil Engineer of the Florida Central & Peninsular. Mr. Denham then became Assistant Engineer of the Florida Southern. From 1885 to 1888 he was Assistant Superintendent of the St. John & Hustis and for a year following General Roadmaster of this road and the Florida Southern. He was then promoted to General Superintendent of the Jacksonville, Tampa & Key West and held that office from 1892 to 1894, and thereafter was Superintendent of the Fourth and Sixth Divisions of the Plant System until his recent promotion.

—Mr. R. B. Fowler, who resigned as General Superintendent of the New Orleans & Western and the Port Chalmette Terminal at New Orleans on Dec. 15 last, was born in Missouri in July, 1861. He entered railroad service as freight brakeman on the Denver & Rio Grande in 1881, then for five years he served in various clerical capacities with the Missouri, Kansas & Texas and the Wabash at Hannibal, Mo. He was clerk in the office of the Superintendent on the Neosho Division of the Missouri, Kansas & Texas in 1886 at Council Grove, Kan. He then went to Parsons, Kan., as clerk in charge of railroad accounts in the office of the General Superintendent. In February, 1887, he became Chief Clerk in the office of Superintendent of the Arkansas lines of the Gould Southwest System at Little Rock. In September, 1893, he became Superintendent of the White & Black River Valley, remaining with that road until January, 1897, when he accepted the position from which he recently resigned.

—Mr. C. C. Smith died at Sherbrooke, Canada, on the 24 inst. Mr. Smith's railroad work began over 50 years ago in the building of the old Central Vermont Railroad. He did much work in Ohio and Kentucky and then moved to Wisconsin. He made that State his home for 20 years or more, doing work on the principal roads in the Middle and Western States. In 1871 and 1872 Mr. Smith took the contract for building the old Jacksonville, Pensacola & Western in Florida, a work backed by the State of Florida. After the work was well advanced the State annulled the bonds which it had guaranteed, and this unfortunate turn of affairs nearly ruined Mr. Smith financially. Mr. Smith built the first Northern Pacific docks at Duluth, Minn., in Jay Cooke's time, and had large contracts with him at the time of Cooke's failure; he also built the first large iron ore docks at Ashland, Wis. Going to Canada he did work on the old Great Western, the Canadian Pacific, the Orford Mountain, the Quebec Central railways.

—Mr. F. M. Aldridge, whose resignation as General Superintendent of the Gulf, Beaumont & Kansas City at Beaumont, Tex., was recently noted, was born in Limestone County, Texas, May 26, 1863. He began railroad service as a brakeman in 1883 on what is now the Salem Division of the Texas & New Orleans and continued braking for three years. He ran as express messenger for Wells, Fargo & Company during 1886, between Houston and San Antonio and then served as freight and passenger conductor on the same road and division for the following five years. After being out of railroad service for a year he entered the service of the Gulf, Beaumont & Kansas City in May, 1894, first as freight conductor and then as Superintendent of Train and Track. From 1896 he was General Superintendent of the same company, to which were added later the duties of a like position with the Gulf & Interstate. He held these offices until Jan. 31 last. Mr. Aldridge is now in Mexico for a month of prospecting and recreation.

—Col. Alba M. Tucker, who resigned as General Agent of the Erie at Cleveland, O., on Oct. 14, 1897, because of ill health, died on Feb. 7, last at a private sanitarium at Flint, Mich. He was born at West Hartford, Vt., Nov. 14, 1836, and when 14 years old began work as a teamster on the old Central Vermont. He arose steadily through the subordinate positions of ticket agent, freight clerk, etc., until he became General Manager of the Erie Lines West of Salamanca. In 1885 he was Superintendent of divisions on the New York, Pennsylvania & Ohio and the New York, Lake Erie & Western, and later became General Superintendent of the latter road and of the Chicago & Erie. From January, 1891, to Dec. 31, 1895, he was General Superintendent of the New York, Pennsylvania & Ohio and from January, 1896, until his retirement, General Agent of the Erie. He served during the Civil War and enlisted as private in August, 1862. He was mustered out as Brevet-Colonel in 1865. His principal service during the war was in the superintendence of the Government railroads.

ELECTIONS AND APPOINTMENTS.

Atchison, Topeka & Santa Fe.—R. F. Hoffman has been appointed Mechanical Engineer, with headquarters at Topeka, Kan.

The statement that Geo. A. Hancock, Assistant Superintendent of Machinery, was soon to retire was incorrect. Mr. Hancock remains with the company with the title of Master Mechanic of the A., T. & S. F., proper.

Baltimore & Ohio.—J. R. Kearney has been appointed Superintendent Car Service, with headquarters at Camden Station. The office of Assistant Superintendent of Transportation is abolished, effective Feb. 1.

Canada Eastern.—F. L. Robinson has been appointed Auditor and General Passenger Agent, with headquarters at Marysville, N. B., succeeding A. McN. Shaw, resigned, effective Feb. 1.

Canadian Pacific.—A. J. Troup has been appointed Superintendent of the Pacific Division, succeeding H. E. Beasley, transferred.

Chicago & Alton.—V. B. Lang, heretofore Master Mechanic of the Cincinnati, New Orleans & Texas Pacific at Chattanooga, Tenn., has been appointed Master Mechanic of the C. & A., with headquarters at Bloomington, Ill.

Dallas & New Mexico.—The officers of this company, referred to in the Construction column, are: President, H. M. Skelton; Vice President, W. H. McGrath; Treasurer, Kirk Hall; Secretary, T. L. Camp, all of Dallas, Tex.

Grand Trunk.—W. G. Brownlee has been appointed Division Superintendent.

Guadalupe Valley.—The officers of this company are: President, J. M. Brownson, succeeding Uriah Lott; Vice President, G. A. Levi; Treasurer, J. F. Welder, and Secretary, J. D. McDonald. The Directors, including those above mentioned, except Mr. McDonald, are J. K. Hextor, F. C. Proctor and J. M. Haller. (See RR. Construction column, Feb. 10, 1899, p. 108.)

Gulf & Interstate Ry. of Texas.—W. H. Mitchell has been appointed General Auditor, succeeding Mr. Spangler. The office of General Superintendent has been abolished.

Gulf, Beaumont & Kansas City.—H. S. Spangler, General Manager of the Gulf & Interstate Ry. of Texas, has been appointed General Manager of the G., B. & K. C., succeeding F. M. Aldridge, resigned.

Kentucky & Indiana Bridge Co.—B. S. Josselyn has been appointed General Manager, with headquarters at Louisville, Ky.

Lake Shore & Michigan Southern.—D. T. Murray has been appointed Division Superintendent.

Louisville & Nashville.—R. Moran has been appointed Master Mechanic.

Newport & Sherman's Valley.—Horace Beard has been elected Secretary.

Ohio & Little Kanawha.—The officers of this recently incorporated company are: President, F. A. Durban and Secretary and Treasurer, J. H. Sutor. The Directors, in addition to the above, are: W. D. Schultz, H. A. Sharpe and H. B. Dick. (See RR. Construction column, Jan. 19, p. 48.)

Ohio, Tennessee & Carolina.—The officers of this company, recently incorporated, are: President, Wm. Kirby; Vice President, G. L. Maloney; Secretary, I. S. Kirker; Assistant Secretary, R. W. Austin; Treasurer, C. Aebli and Auditor, S. P. Condon. (See RR. Construction column, Dec. 15, 1899, p. 872.)

Pennsylvania Co.—D. B. Johnston, heretofore Engineer Maintenance of Way of the Cincinnati & Muskingum Valley, was on Feb. 1 appointed Engineer Maintenance of Way of the Marietta Division on the P. C.

Pullman Company.—H. M. Pflager, heretofore Chief Mechanical Inspector, has been appointed Mechanican Superintendent, with headquarters at Chicago, Ill.

Salt Lake & Ogden.—J. Fogarty has been appointed General Passenger Agent, with headquarters at Salt Lake City, Utah, succeeding H. W. Early, resigned.

Southern.—J. T. Robinson, formerly Master Mechanic at Selma, Ala., has been appointed Master Mechanic at Spencer, N. C., succeeding W. H. Hudson, resigned. J. F. Sheahan, formerly Foreman at Alexandria, succeeds Mr. Robinson at Selma, Ala.

Southern Pacific.—W. S. Palmer, heretofore Resident Engineer, has been appointed Assistant Division Superintendent, with headquarters at Oakland Pier, Cal., succeeding J. H. Thompson, deceased.

Wheeling & Lake Erie.—John Bean, Master Mechanic at Canton, O., has resigned.

White Pass & Yukon.—J. R. Van Cleve, heretofore Master Mechanic at Kalispell, Mont., of the Great Northern, has been appointed Master Mechanic of the W. P. & Y. This office has recently been created.

Wilmington Seacoast.—E. S. Latimer has been made Traffic Manager, and James H. Chadbourn, Jr., General Passenger Agent.

RAILROAD CONSTRUCTION.
New Incorporations, Surveys, Etc.

ARIZONA & NEW MEXICO.—This 3-ft.-gage line which runs from Lordsburg, N. M., to Clifton, Ariz., 71 miles, is to be practically rebuilt and converted to standard gage. This includes the rebuilding of all bridges.

ALASKA ROADS.—Henry Bratnober, of Tacoma, Wash., representing the Rothschilds and the London Exploration Co., has obtained a charter for a railroad from Pyramid Harbor to the copper district of Rainy Hollow, where the Rothschilds have heavy holdings.

BALTIMORE & OHIO SOUTHWESTERN.—Preparations are being made, according to report, for building the extension under consideration for several years from Beardstown, Ill., west 50 miles to Quincy. Several surveys have been made.

CHICAGO, WEST PULLMAN & SOUTHERN.—This company has been incorporated in Illinois, with a capital stock of $50,000, to build a railroad from Chicago southwest to East St. Louis. The principal office is Chicago. The incorporators and first Board of Directors are: Charles E. Sheldon, Akron, O.; Silas J. Llewellyn; William H. Jones, William O. Jones and James P. Grier, all of Chicago.

COLUMBIA & NEHALEM VALLEY.—This company has made a proposition to the people of St. Helens, Ore., to build a railroad from that city west about 16 miles to Pittsburg. They ask for boomage at St. Helens, and terminal grounds at either end of the route; also right of way and timber from three sections of the land. The company agrees to begin building the road within six months and to complete it within 2½ years from the beginning of rail laying. The central office is at St. Helens, Ore.

CONQUISTA COAL.—This company was incorporated in New York Feb. 8, with a capital stock of $80,000, to build a standard gage steam line eight miles long in the State of Coahuila, Mexico, to run from Barroteram on the Mexican International northwest to the Mota del Cura coal mines. The principal office is New York City. Among the incorporators are: James T. Gardiner and Howard Dutcher, 21 Cortlandt St., New York; John L. Elliot and Edward D. Peters, 71 Broadway; George F. Peabody, Chas. J. Peabody, Acosta Nichols, Louis G. Myers and Cecil Barrett, 27 Pine St., New York.

DALLAS & NEW MEXICO.—The route of this proposed line is from Dallas, Tex., northwest to Aubuquerque, N. M. Some years ago 70 miles of the road was graded and a surveying party will soon go over this old grade. The line has been located for 135 miles where it reaches the heart of the coal country. No contracts are let. The officers are given under Elections and Appointments.

DARDANELLE & OLA.—State Land Commissioner Colquitt has taken away 10,000 acres of State lands in Yell County, Ark., formerly granted to this company by special act of the last Legislature. The road has been surveyed from Dardanelle south about 85 miles to Hot Springs, and considerable right of way obtained. Work has been abandoned for the present. John H. Pope of Dardanelle is President. (Sept. 15, 1899, p. 649.)

DAVENPORT, ROCK ISLAND & NORTHWESTERN.—This company which, under the charter of the Davenport, Clinton & Eastern, has just completed a line from Davenport, Ia., northeast 30 miles to Clinton (Oct. 6, p. 701), proposes to build an extension from Davenport southeast about 85 miles to Peoria. It crosses the river over the Crescent bridge at Davenport. This is a corporation of the American Steel & Wire Co., of which John W. Gates is President, Chicago, Ill.

DULUTH, SOUTH SHORE & ATLANTIC.—Balch & Peppard of St. Paul, Minn., have the contract, according to report, for building 30 miles of extension from Lake Gogebic, Mich., to connect with its Mineral Range branch at Mass City.

FORT DODGE & SOUTHWESTERN.—This company has been formed in Iowa, with a capital stock of $250,000, to build a railroad from Fort Dodge southeast about 25 miles to Stanhope on the Chicago & Northwestern to Story City. Among the incorporators are S. T. Meservey, of Fort Dodge, who is also interested in the Mason City & Fort Dodge and the Marshalltown & Dakota; also E. H. Rich, cashier of the First National Bank at Fort Dodge. (Iowa Roads, Feb. 9, p. 95.)

GRAND TRUNK.—An officer writes that nothing has been determined as to the proposed new line from Port Hope, Ont., to Port Union.

GREAT FALLS & OLD DOMINION. —This company proposes to build a line in Virginia from the

aqueduct bridge at Georgetown, D. C., to the great falls of the Potomac, and probably to Fairfax, C. H. The charter gives the right to build branches not to exceed 20 miles. Joseph S. Miller, of Washington, D. C., is President. It is the road recently referred to under the title of the Old Dominion & Grand Valley. (Feb. 9, p. 96.)

GREAT NORTHERN.—Surveys are reported completed for a line to parallel the Duluth, Missabe & Northern, running within three miles of that line north about 50 miles through Columbia Junction to Nelson, Minn. The St. Louis River will be crossed at Columbia Junction.

An extension is proposed, according to report, from Virginia, Minn., to run east about 70 miles to Beaver Bay on Lake Superior.

Work is to be resumed in the spring, according to report, on the extension from St. Bonifacius, Minn., northeast about six miles to Spring Park on Lake Minnetonka. It is said that the road is to be further extended to Hutchinson. (Nov. 17, 1899, p. 800.)

IDAHO MIDLAND.—The people of Boise City, Id., have been asked to give right of way through that city for this proposed line from Boise City northeast about 300 miles to Butte, Mont. Cross-sectioning is to be begun at once, and it is stated that grading will be started in a few days. The contract for a section is reported let. Thomas W. Bates, of Boise, is President. (Jan. 26, p. 64.)

ILLINOIS CENTRAL.—An extension of the Yazoo Delta is being built from Isola, Miss., on Lake Dawson, to run southeast about nine miles to Belsola. The line from Moorehead south to Isola was completed last year. J. C. Neely has the contract for grading, of which about 80 per cent. is completed. There are 50 men and teams at work. The work is light with low grades.

MISCELLANEOUS COMPANIES.—The Municipal Construction Co. of New York City has been incorporated to build railroads, tunnels, etc. Thomas F. Powers of Brooklyn, and Moritz Frank of New York City, are among the incorporators.

NEW BRUNSWICK ROADS.—Several lumbermen, including Messrs. Welsh & Lynch, of Woodstock, propose to build a railroad from that place to Bristol and Foreston, about 15 miles. Surveys will be made by C. LeB. Miles.

NEW YORK ROADS.—The Duerr Contracting Co. will build a spur, according to report, from their plant northeast of Le Roy to connect with the New York Central at Bergen.

NICKEL BELT LINE.—Messrs. Barwick, Aylsworth & Wright, of Toronto, have given notice of application to the Parliament of Ontario for a charter to build a line from a point in the township of Dowling, District of Nipisoning, at or near Onaping Station on the main line of the C. P. R. to run northeast through the townships of Dowling, Levack, etc., to Wissner township, and thence southeast through the townships of Norman, etc., to a point on the Stobie Branch of the C. P. R.

NORTHERN PACIFIC.—An officer writes that the report that the company will build an extension from Whitehall, Mont., to Jefferson Island is in error, as such construction has not been authorized. (Jan. 12, p. 30.)

NOVA SCOTIA STEEL COMPANY'S RAILWAY.—Active work is to be begun in the spring, according to report, for an extension of this line from Sunny Brae, N. S., east to Country Harbor. The line now runs from Ferrona Junction on the Intercolonial, southeast 12½ miles to Sunny Brae.

ONTARIO ROADS.—George E. Kidd, of Ottawa, will ask incorporation for a company to build from that city to Brockville.

PENNSYLVANIA.—Proposals are asked for four-tracking portions of the main line of the Philadelphia Division between Coatesville and Atglen, Pa. Two additional tracks will be needed between Coatesville and Hope's Tower, and one track from that point to Atglen.

On the Middle Division the road is to be four-tracked in the vicinity of Huntingdon, Pa. The line is to be changed for several miles from a point one mile west of that city. One additional track will be needed between Petersburg and Barree.

The company is also inviting proposals for double-tracking the Waverly & Passaic and for building two new passenger tracks across Newark Meadows from Hackensack Bridge to East Newark, N. J.

The people of Mullica Hill and Ewan are circulating petitions for a line from the Salem Branch of the West Jersey & Seashore line, to run east about five miles to Mullica Hill, and probably to Ewan. R. E. Costello of Mullica Hill, and S. P. Clark of Ewan, are circulating the petitions.

Extensive improvements have been determined upon, according to report, at the yards at Harrisburg, Pa., including 15 additional tracks.

An officer states that the company has not agreed upon any plans, as yet, to raise the tracks through the city of New Brunswick. The idea is to raise the road high enough to build stone arches over the streets in the city, if the city of New Brunswick will change the line so as to cross under the railroad more nearly at right angles than at present.

PENNSYLVANIA COMPANY.—The Pound Construction Co. of Chicago has taken the contract for grading, and Geo. F. Egan of Pittsburgh, Pa., for masonry work, on the two miles of second track and sidings between Wheelock, O., and Bedford, on the Cleveland & Pittsburgh. (Jan. 26, p. 64.)

PHILLIPS & RANGELEY.—A. F. Hilton is to make exploration this month for an extension to Redington, Me.

PONTIAC PACIFIC JUNCTION.—The company has applied to the Dominion Parliament for power to extend its line. This is probably the extension of nine miles for which contracts were recently let to R. J. Beemer. (Dec. 28, 1899, p. 901.)

QUEBEC & LAKE HURON.—This company whose application for incorporation was noted last week (p. 96), proposes to build an air line road from the mouth of the French River on Georgian Bay, to run east to Quebec. This would give a grain route from the Great Lakes to a seaport 250 miles shorter than any existing road. It is proposed to build a line of light grades and curves, and to erect many elevators at either end. Among the promoters are: S. F. Angus, of the Detroit, Ypsilanti & Ann Arbor Road; W. L. Holmes, President of the Detroit Telephone Co., and Frederick W. Hayes, President of the Preston Bank.

QUEEN & CRESCENT.—Bids are asked for building 1.3 miles of road for the Cinncinnati Southern around tunnel 27 near Harriman, Tenn. (Jan. 19, p. 48.)

RESTIGOUCHE & WESTERN.—Wm. Pugsley, of Campbellton, N. S., has made application to Parliament to build an extension of the road, including a railroad bridge across the St. John River at a point between Grand Falls and Edmondston. (Feb. 10, 1899, p. 109.)

RIO GRANDE WESTERN.—Contracts are let, according to report, for eight miles more extension on the Sunnyside Branch of the Carbon County line. It has recently been completed from Mounds Station to Sunnyside, 17.78 miles. (Dec. 1, 1899, p. 836.)

ROCHESTER & ST. CLAIR.—Surveys are reported in progress for this line from Rochester, Mich., on the Michigan Central, to run east 18 miles to Lenox on another branch of the M. C. Justin R. Whiting of St. Clair is President.

ST. LOUIS & SAN FRANCISCO.—With reference to the extension from Sapulpa, I. T., an officer writes that it will extend southwest through Okmulgee, capital of the Creek Nation near Holdenville or Wenoka, and thence west by south through Tishomingo, capital of the Choctaw Nation, and to the Red River in Texas. Johnston Bros. & Faught of St. Elmo, Ill., have taken the contract for the entire line. Their local office will be at Sapulpa, I. T. The line is to be laid with 70-lb. rails and stone ballast. (Feb. 9, p. 96.)

ST. LOUIS TERMINAL.—This company is building a belt line in St. Louis, Mo., from Carrie Ave. to Bittner St., just north of the St. Louis Car Company's plant, 2.3 miles, and from Bittner St. to the city limits, 1.5 miles, making a total of 3.8 miles. The work is being done by the company and about 1½ miles of track is laid. The maximum curve is 12°. J. S. Walsh is President, and E. P. Bryan, Vice President and General Manager, both of St. Louis, and holding similar positions in the Terminal RR. Association of St. Louis. (March 17, 1899, p. 198.)

SALT LAKE VALLEY.—This company was incorporated in Utah Feb. 6, with a capital stock of $32,000, to build a railroad from Salt Lake City to Ogden, 32 miles. Among the incorporators are: Arthur Kennedy, President, South Bend, Ind.; Charles A. Quigley, Thaddeus W. Naylor, William P. Hemphill and Frank L. Beatie of Salt Lake.

SOUTHERN NATIONAL & INTERNATIONAL.—Under this title a road is projected to connect the four states of Yucatan, Campeche, Tabasco and Chiapas with the general railroad system of the Republic. It is to touch the following points: Campeche, Lerma, Monte Claro, Tumbala, Juarez and Carmen el Juile, connecting at the latter point with the Isthmus Road. This involves about 410 miles of road and much difficult engineering work. The capital so far subscribed is about $10,000,000, this, including a subvention of $6,000,000 to be given by the Federal Government. Other subsidies are to be asked from the various state legislatures. Senor Francisco Z. Mena, Minister of Public Works at Mexico City, is giving considerable attention to the project. Notice has already appeared of this road under Mexican Northern & International. (Dec. 8, 1899, p. 853.)

TENNESSEE ROADS.—J. C. Monday & Co. of Knoxville have been awarded a contract to build a railroad 1.2 miles long between Briceville and Minersville to open up certain coal fields.

WARREN COUNTY.—The State Railroad Commission has granted the application of this company to build its proposed line from Warrensburg, N. Y., south about 10 miles to Caldwell on the Delaware & Hudson. (Nov. 3, 1899, p. 770.)

WASHINGTON, ST. MARY'S BAY & POINT LOOKOUT.—Work has been resumed, according to report, on this line from Washington, D. C., southeast to Point Lookout, Md. A. B. Lindeman, of Philadelphia, is President.

XICO.—Under this title a narrow gage road has been built from Mexico City southeast about 35 miles to Ecatzingo, and is being extended on toward Atlixco, State of Puebla.

YORKTOWN, POQUOSON & HAMPTON.—A bill has been passed by the Virginia Senate to incorporate this company to build from Yorktown southeast about 15 miles to Hampton.

YUMA & GULF OF CALIFORNIA.—The proposed line of Captain Alfonso B. Smith, of Los Angeles, in Mexico, is reported completed from the Adair Bay on the Gulf of California, north to the International line, and is to be extended to Yuma, Cal., and San Diego. (Sept. 29, 1899, p. 686.)

GENERAL RAILROAD NEWS.

BALTIMORE & OHIO.—Of the $8,600,000 4 per cent. bonds of the B. & O., and the $2,500,000 3½ per cent. of the Baltimore & Ohio Southwestern which have been sold to Kuhn, Loeb & Co., and Speyer & Co., New York, the larger portion will be used by bonds of the Pittsburgh & Western, of which about $8,400,000 were deposited with J. P. Morgan & Co., under an agreement providing for such sale. The remainder will be used to make improvements on the B. & O., including second track and better terminal facilities, also for reducing grades between Baltimore and Chicago. The maximum grade for eastbound traffic is to be 18 feet, except over special places in the mountains. (Feb. 9, p. 96.)

BRADFORD CENTRAL.—A first mortgage has been filed to the Knickerbocker Trust Co., New York, as trustee, to secure 50-year 5 per cent. gold bonds, dated July 1, 1899, to the amount of $25,000 per mile on its proposed line from Ansonia, Pa., east through Canton to Towanda, with branches and extensions. After five years the sum of $11.11 on each $1,000 bond outstanding is to be set aside on April 1 and Oct. 1 each year until maturity for the sinking fund. George W. Adams is President and F. A. Sawyer, Secretary. The main office is Towanda, Pa. (Railroad Construction column, Feb. 2, p. 79.)

CENTRAL OF GEORGIA.—Judge Hart at Augusta, Ga., has again denied the petition that this company be enjoined from buying the Middle Georgia & Atlantic on the ground that it is a competing road. (Sept. 29, 1899, p. 686.)

CENTRAL PACIFIC.—About $900,000 of the new 3½ per cent. bonds are to be cancelled from the proceeds of the old C. P. sinking fund. The bonds were bought in the open market. (Dec. 1, 1899, p. 836.)

CHICAGO, BURLINGTON & QUINCY.—Lee, Higginson & Co., Boston, have bought $2,000,000 of 3½ per cent. Illinois Division bonds, the reported price being 103 and interest. A portion of the proceeds will be used to refund $1,076,000 of Ottawa, Oswego & Fox River 8 per cent. bonds which mature July 1. (Aug. 11, 1899, p. 576.)

CHICAGO GREAT WESTERN.—At a meeting in London Jan. 24, of the holders of the 4 per cent. debenture stock, and of the 5 per cent. preferred stock A, the issue of an additional $2,000,000 of 4 per cent. debenture stock was authorized, the proceeds to be devoted to capital expenditures for 1900, and for additions and improvements. Any surplus is to be held available for similar expenditures in the future. The proposals provide for the expenditure of more than $3,000,000, of which $1,210,000 is needed for equipment; $360,000 for additional space and facilities at Chicago and Kansas City; $387,000 for maturing obligations, and $1,329,000 for improvements to the line. At the meeting Vice-President Oppenheim stated that the full dividend has been earned on the preferred stock A, and that it is expected that the profits will be sufficient to pay a dividend on B stock and leave a surplus.

CHICAGO JUNCTION RAILWAYS & UNION STOCK YARDS.—The stockholders at Jersey City, N. J., on Feb. 8, voted to make the preferred stock a 6 per cent. cumulative, payable quarterly. (Jan. 19, p. 48.)

COLUMBUS & MAYSVILLE.—The security holders of this line have reached an agreement and the receiver has been discharged. The road has been operated under lease by the Hillsboro RR., and runs from Hillsboro to Sardinia, O., 19 miles.

DELAWARE RIVER.—Senator Stokes has introduced a bill into the New Jersey Legislature to merge this company with the West Jersey & Seashore line of the Pennsylvania. The line runs from Woodbury, N. J., to Penn's Grove, 19.97 miles. Its capital stock is $225,000 and its funded debt $65,000.

EUREKA SPRINGS.—The property of this company on Feb. 5 was turned over to the successor company, the St. Louis & North Arkansas. (Sept. 29, 1899, p. 686.)

FITCHBURG.—Judge Knowlton in the Supreme Court at Boston, Feb. 8, refused to restrain Governor Crane and other State officers from voting in favor of the lease of the Fitchburg to the Boston & Maine, as prayed for in the bill of equity brought by James M. Hilton of Cambridge, a stockholder of the Fitchburg. Judge Knowlton stated that all the officials could do would be to make a provisional arrangement subject to the consideration of the Legislature. (Feb. 9, p. 96.)

The directors on Feb. 13, by a vote of seven to six, decided to reject the proposed lease of the road to the Boston & Maine. Among those who voted in favor were the three State directors.

KENTUCKY & INDIANA BRIDGE.—The property of this company was transferred to the successor corporation, the Kentucky & Indiana Bridge & Terminal Co., at 12 o'clock, Jan. 31. The property is to be operated for the Southern Ry., and the Baltimore & Ohio Southwestern. B. S. Josselyn is General Manager.

MARION & RYE VALLEY.—This property was sold on Feb. 3 at Marion, Va., to the bondholders for $7,000. The line runs from Marion to Currin Valley, 6.5 miles. (Dec. 22, 1898, p. 888.)

NORTHERN CENTRAL.—At the annual meeting, Feb. 23, stockholders will be asked to vote for an increase of $4,000,000 capital stock to pay for bonds maturing soon. (Feb. 2, p. 80.)

PHILADELPHIA & READING.—The Executive Committee has recommended that a semi-annual dividend of 1½ per cent. be declared on the first preferred stock of the Reading Co., payable March 8. This is the first dividend since the reorganization in 1896.

SAGINAW, TUSCOLA & HURON.—This property has been acquired by the Pere Marquette Co. The transfer took place Feb. 1. The line runs from Saginaw, Mich., to Bad Axe., 64.34 miles, with two short branches, making a total of 66.57 miles.

SARATOGA NORTHERN.—Justice Houghton at Saratoga Springs, N. Y., has appointed Joseph A. Powers receiver of this line, which runs from Saratoga to Mt. McGregor, 10 miles. The capital stock is $16,000.

SEABOARD AIR LINE.—The Managing Committee notifies subscribers to the greater S. A. L. organization agreement of Jan. 5 that the agreement has become effective, and the depositary, the Continental Trust Co., will issue certificates thereunder upon application at its office in Baltimore, Md. (Jan. 26, p. 64.)

UNION PACIFIC.—The directors have declared a semi-annual dividend of 1½ per cent. on the common stock, and the regular semi-annual dividend of 2 per cent. on the preferred stock, payable April 2. This is the first dividend on the common stock since the reorganization. Statements submitted to the Board of Directors show accumulations of earnings of the system, including the Oregon Short Line and the Oregon Railroad & Navigation Co. to Dec. 31, 1899, of $12,994,533, exclusive of charges of $3,000,000 for betterments and equipment. The cash on hand Feb. 7, 1900, was $8,698,985. The surplus earnings for the year, not including the amounts paid from income for capital expenditures, were more than double the dividend declared on the common stock.

WISCONSIN CENTRAL.—Proposals will be received up to Feb. 21 for the sale of sinking fund first series bonds of Jan. 1, 1879, to the amount of $60,000. Payment is to be made on March 1.

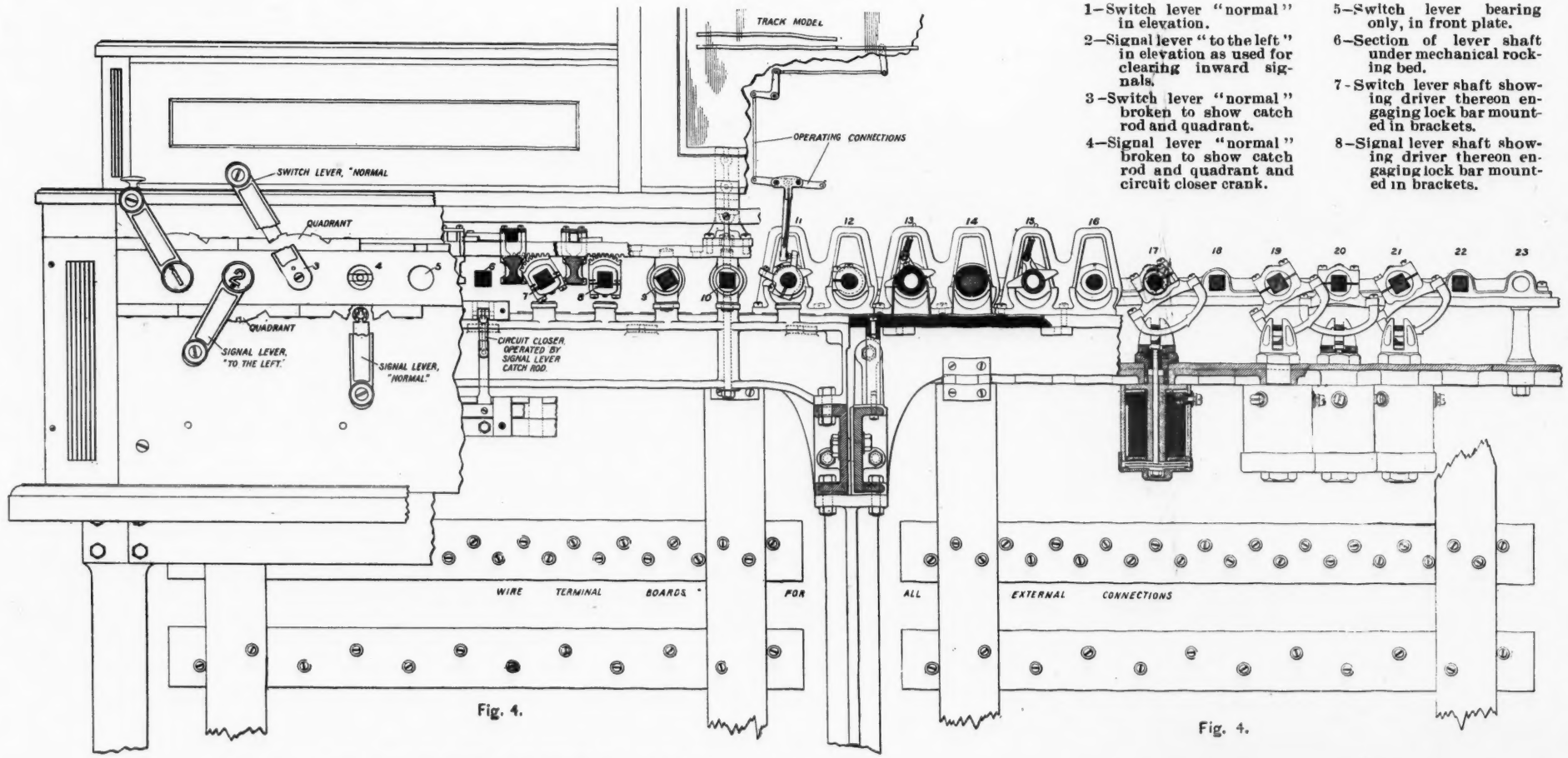


Fig. 4.

1—Switch lever "normal" in elevation.
2—Signal lever "to the left" in elevation as used for clearing inward signals.
3—Switch lever "normal" broken to show catch rod and quadrant.
4—Signal lever "normal" broken to show catch rod and quadrant and circuit closer crank.
5—Switch lever bearing only, in front plate.
6—Section of lever shaft under mechanical rocking bed.
7—Switch lever shaft showing driver thereon engaging lock bar mounted in brackets.
8—Signal lever shaft showing driver thereon engaging lock bar mounted in brackets.
9-10 Intermediate shaft bearings under track model.
11—Section of switch shaft through coupling, and track model operating device.
12—Coupling on shaft of signal lever under track model.
13—Section through rubber roller of switch lever showing contacts of "quick switch"
14—Section through rubber roller of signal lever showing contacts of controlling signals.
15—Section through mechanism of "quick switch" in normal position.
16—Section through shaft bearing.
17—Section of switch indication maguet showing construction and arrangement of "reverse" segment.
18—Section of signal lever shaft.
19—Elevation of switch indication magnet and "reverse" segment engaging it.
20—Elevation of signal lever lock magnet and segment on shaft engaging it.
21—Elevation of switch indication magnet and "normal" indication segment.
22—Section of signal lever shaft.
23—Elevation of rear bearing.

Fig. 5. SECTIONAL VIEW OF MACHINE ON CENTER LINE OF SIGNAL LEVER.

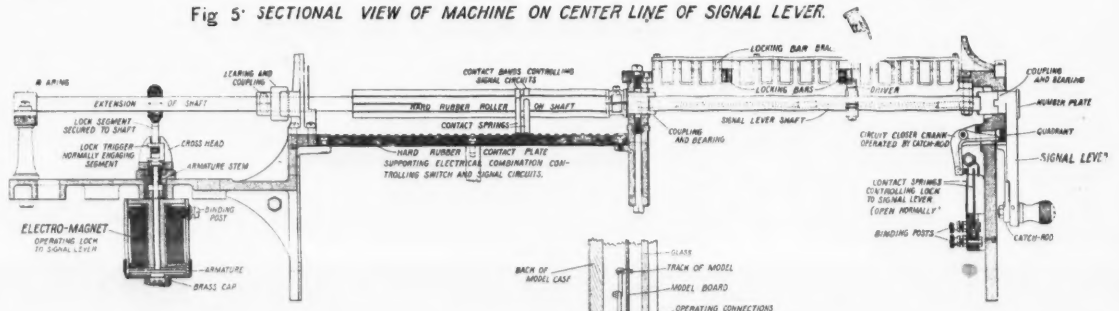
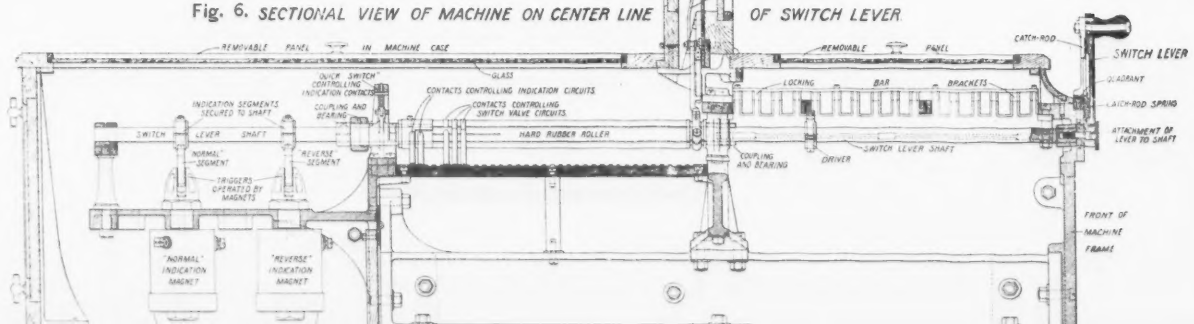


Fig. 6. SECTIONAL VIEW OF MACHINE ON CENTER LINE OF SWITCH LEVER.



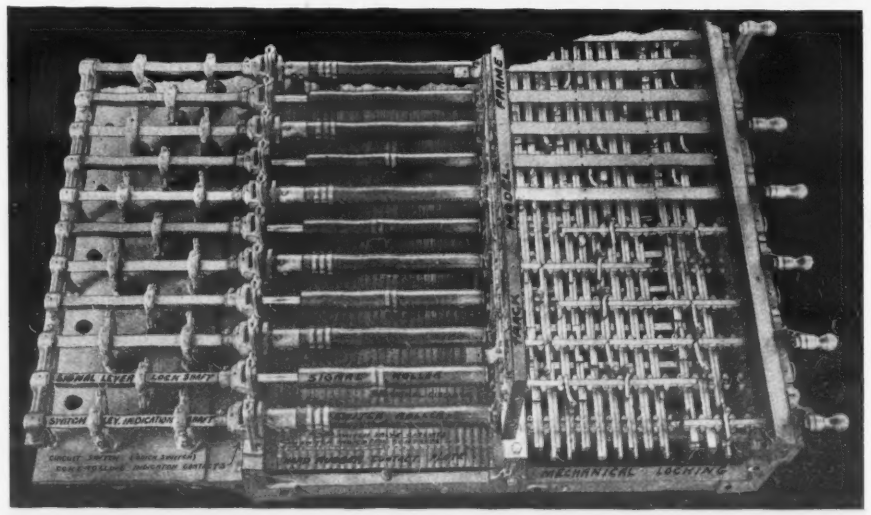
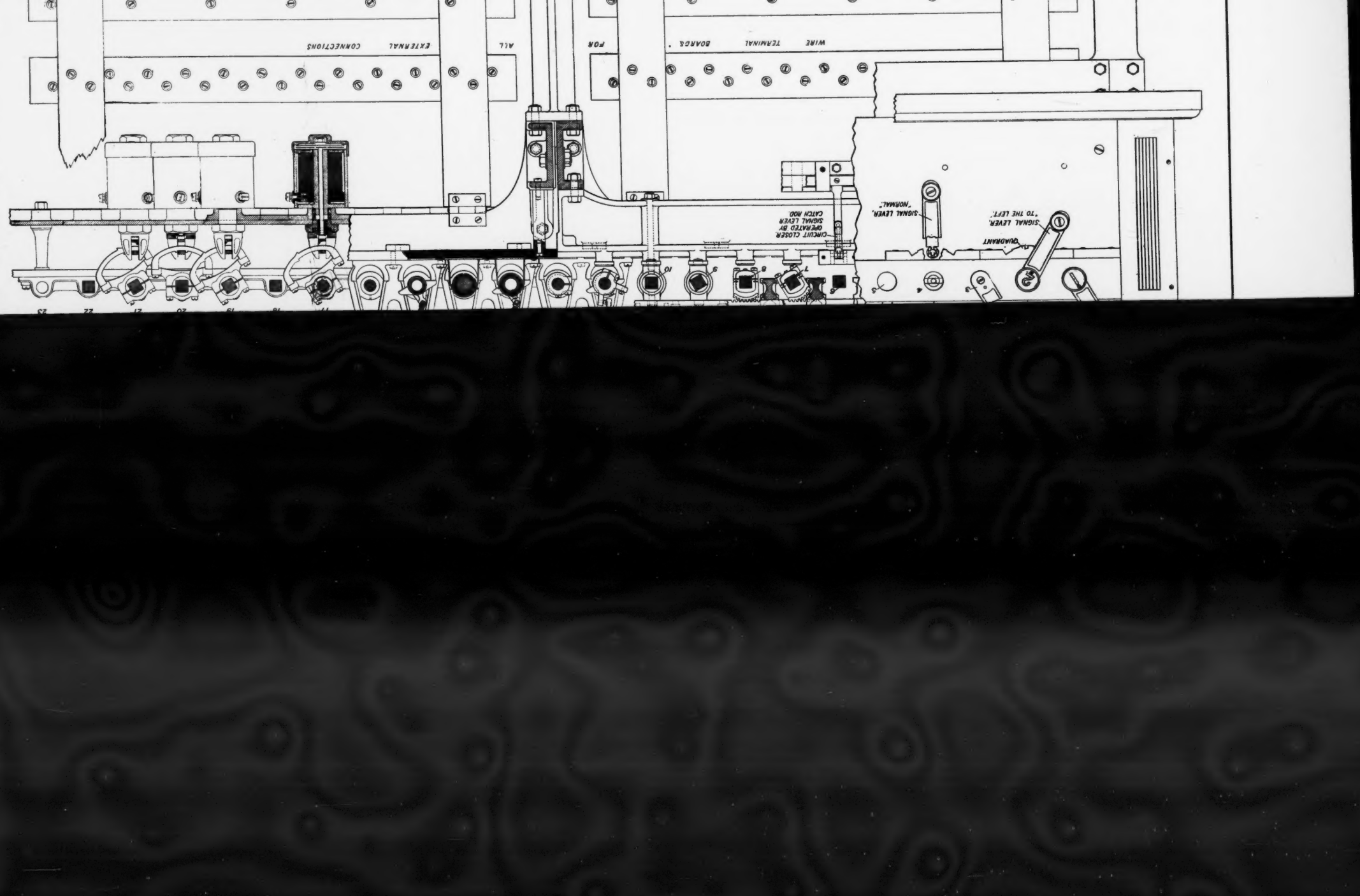


Fig. Y.



controlling signals.

15—Section through mechanism of "quick switch" in normal position.

16—Section through slant bearing.

17—Section of switch indication magnet showing construction and arrangement of "reverse" segment.

18—Section of signal lever shaft.

19—Elevation of switch indication magnet and "reverse" segment engaging it.

20—Elevation of signal lever lock magnet and segment on shaft engaging it.

21—Elevation of switch indication magnet and "normal" indication segment.

22—Section of signal lever shaft.

23—Elevation of rear bearing.

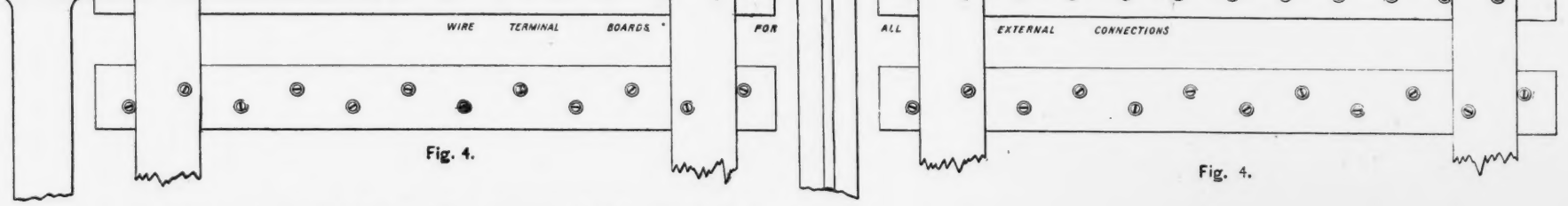


Fig. 4.

Fig. 4.

21—Elevation of switch indication magnet and "normal" indication segment.
22—Section of signal lever shaft.
23—Elevation of rear bearing.

Fig 5. SECTIONAL VIEW OF MACHINE ON CENTER LINE OF SIGNAL LEVER.

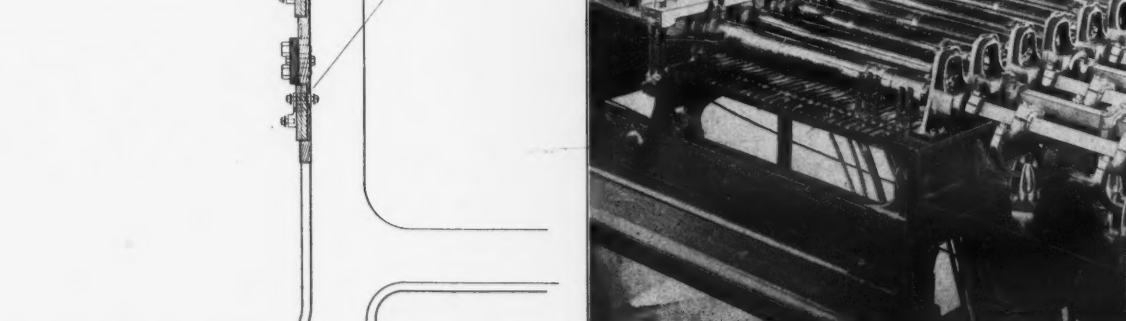


Fig. 6. SECTIONAL VIEW OF MACHINE ON CENTER LINE OF SWITCH LEVER.

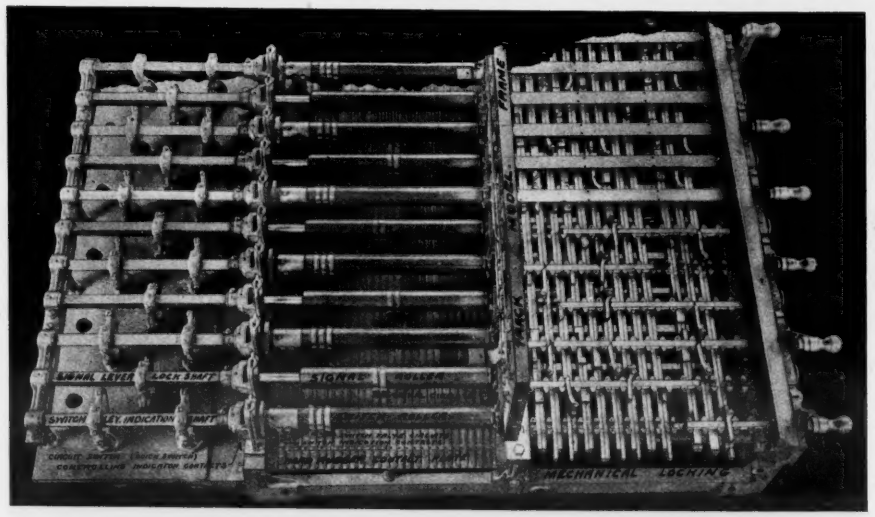


Fig. Y.

Fig. X.

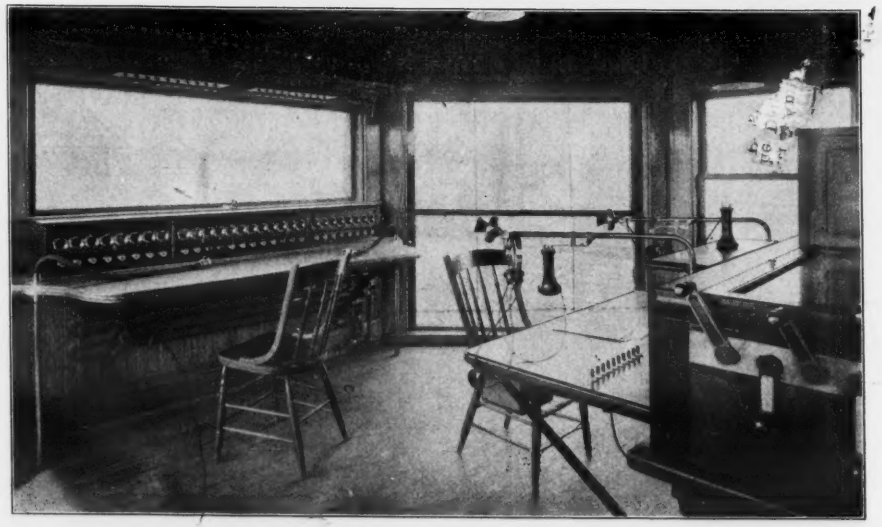


Fig. Z.—Director's Desk, Tower No. 1, Boston.

THE WESTINGHOUSE ELECTRO-PNEUMATIC INTERLOCKING MACHINE.—With Paper by Mr. J. P. Coleman.